Standard Size, 9 x 12. JUNE 5, 1902. Price Eight Cents.

PUBLIC LIBRARY CITY OF DETROIT

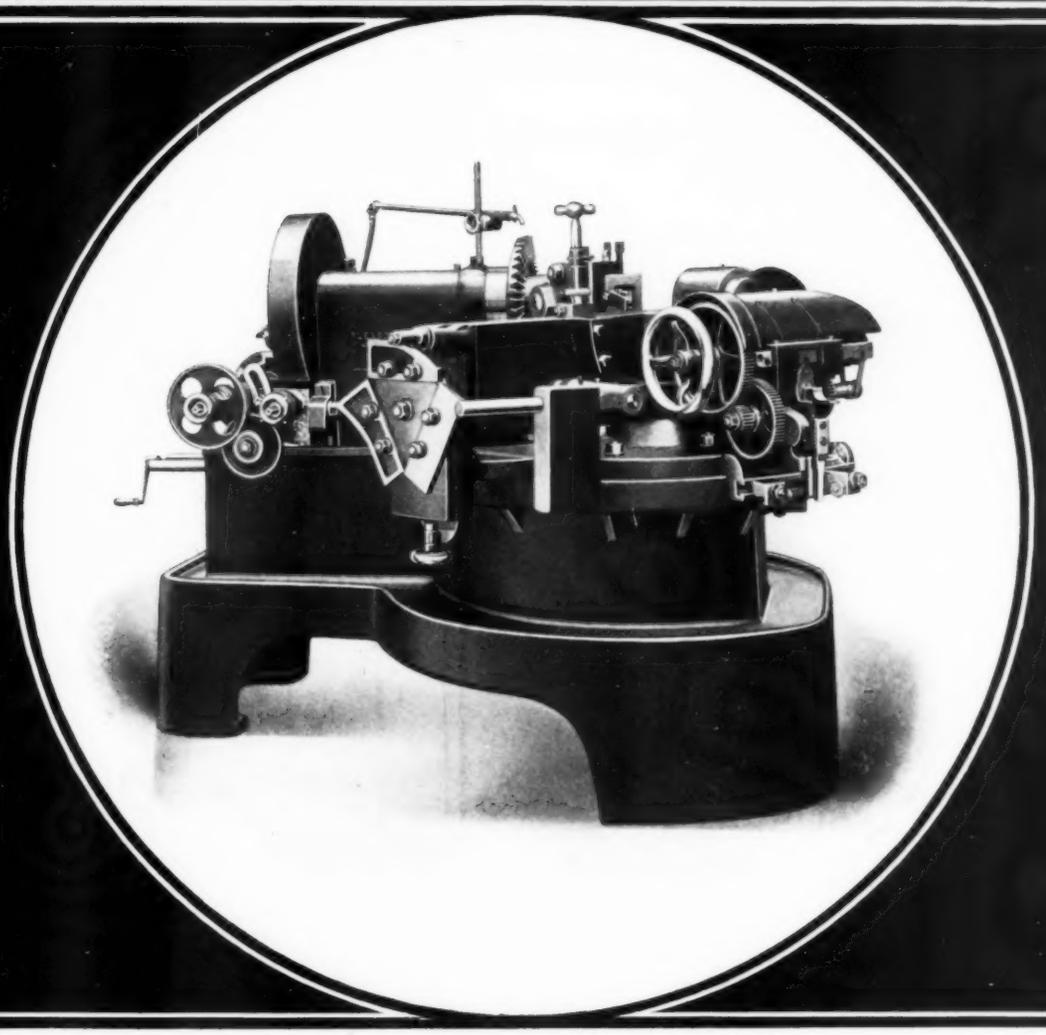
AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 25. WORLD BUILDING, NEW YORK. No. 23.

Index to Advertisers and Classified Index Following Reading Matter.



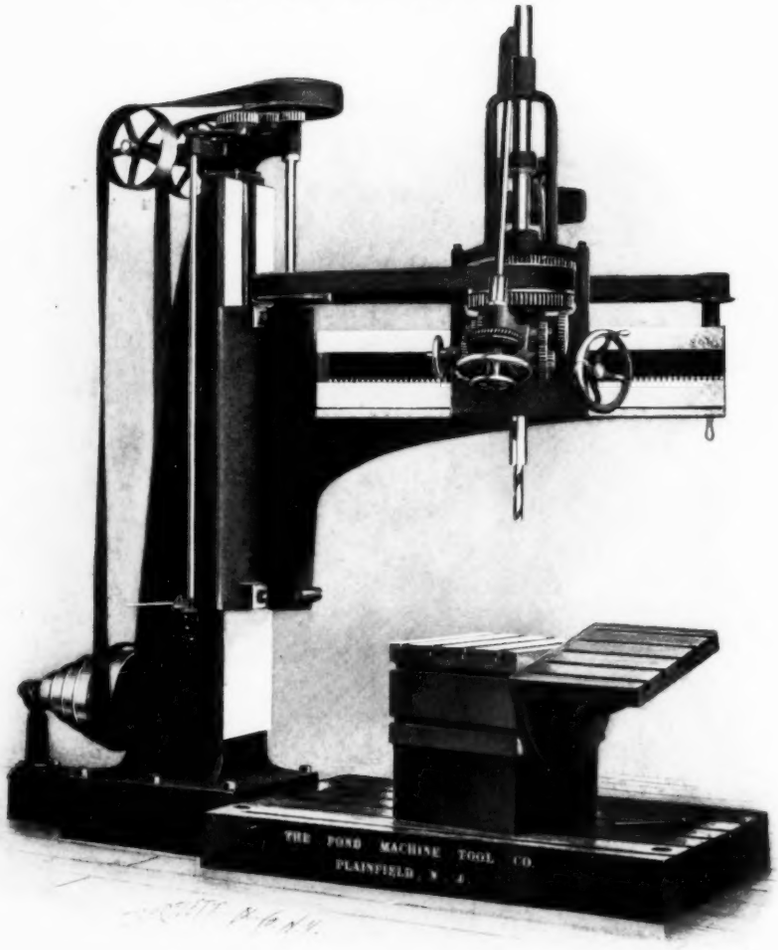
Gear Planers give the advantage of accuracy on Bevel Gears of all sizes and of fast time on Spurs over 1½ D.P. The first investment includes a full set of formers of standard curve.

Gleason Tool Co.,

Gear Planers and Gears. ROCHESTER, N.Y.

POND RADIAL DRILLS.

5′ TO 8′ ARMS.



Pond 6-foot Radial Drill as regularly furnished to stand parallel with the line shaft, with box table having swivel shelf.

May be furnished to stand at right angle to the line shaft. If desired, these radials can be furnished with friction reversible countershaft, or without box table.

AN ESPECIALLY STIFF TOOL

Built for the heaviest requirements of Modern Practice.

THE POND MACHINE TOOL CO.,

PLAINFIELD, N. J.

NEW YORK—136-138 Liberty St.
PHILADELPHIA—21st and Callowhill Sts.
BOSTON—144 Pearl St.

PITTSBURGH—Frick Building.
CHICAGO—Western Union Building.
ST. LOUIS—516 North 3rd St.
MONTREAL—50 Cathcart St., Charles Spalding.

LONDON—23-25 Victoria St., S. W.
PARIS—Adolphe Janssens.
ST. PETERSBURG—Atalanta Technical Agency.

Two Draw-Stroke Shapers.

The accompanying half-tones illustrate two types of shapers built by Baker Bros., of Toledo, Ohio. While the two machines shown are alike as regards design of bed, table and feeding mechanism, different methods are employed for supporting the cutter bars and also for driving—one machine being belted and the other motor driven. These shapers act upon the draw-stroke principle and are very rigid—the pull of the cut being directly down upon the bed. They are designed for removing rapidly large quantities of metal, and are well adapted for such work as machining off the gates and risers from steel castings, and, in fact, for handling all kinds of heavy shaper work.

The shaper shown in Fig. 1—driven by a Westinghouse motor—is geared in a manner giving it four changes of speed. The cutter bar is backed up by a shoe below the table and is supported at the upper end. The table feeding and the cutter relieving devices, on both this and the belt-driven machines, are practically the same as used on the keyseater described on page 186.

In the belt-driven machine, shown in Fig. 2, the cutter-bar rests in a semi-circular shoe extending the entire distance back of the tool; thus the bar is supported at all times, and there is no chance for the tool to spring away from the work. The ram is driven by rack and pinion and has a quick return. The driving pulley is 20 inches in diameter and takes a 5-inch belt. It will be noticed this machine carries a very heavy vise. The jaws are 24 inches wide, 5 inches deep and will take in 20 inches between the tool-steel faces. The upper jaw is

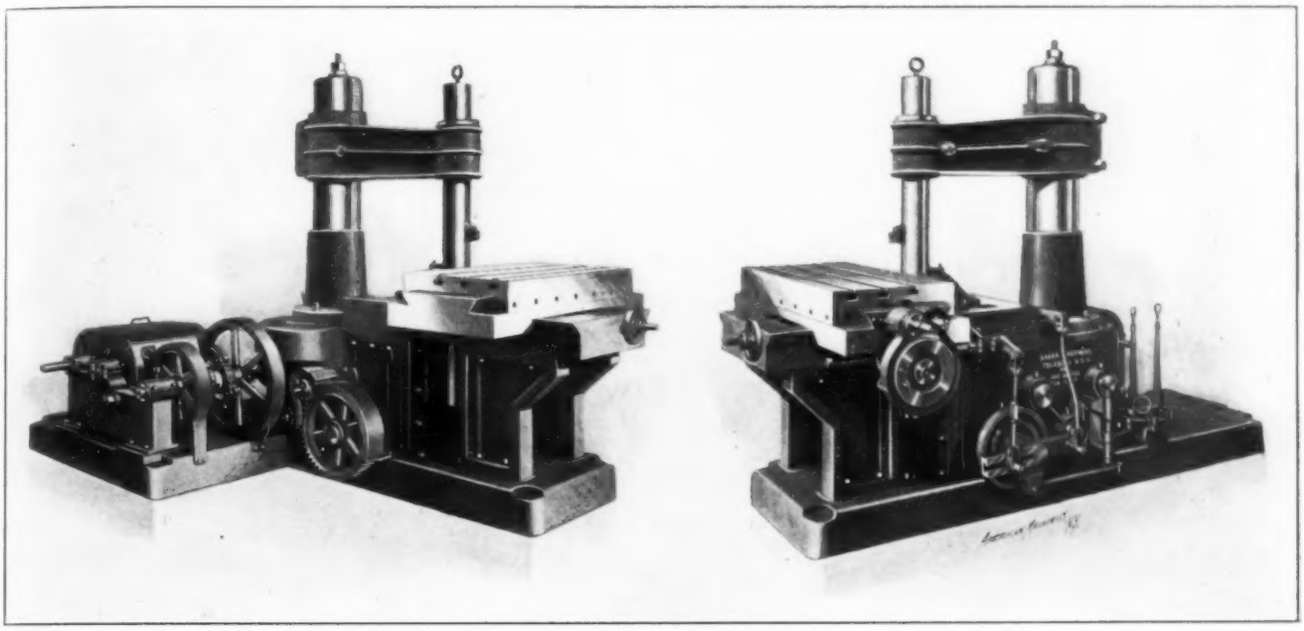


FIG. 1. MOTOR-DRIVEN SHAPER.

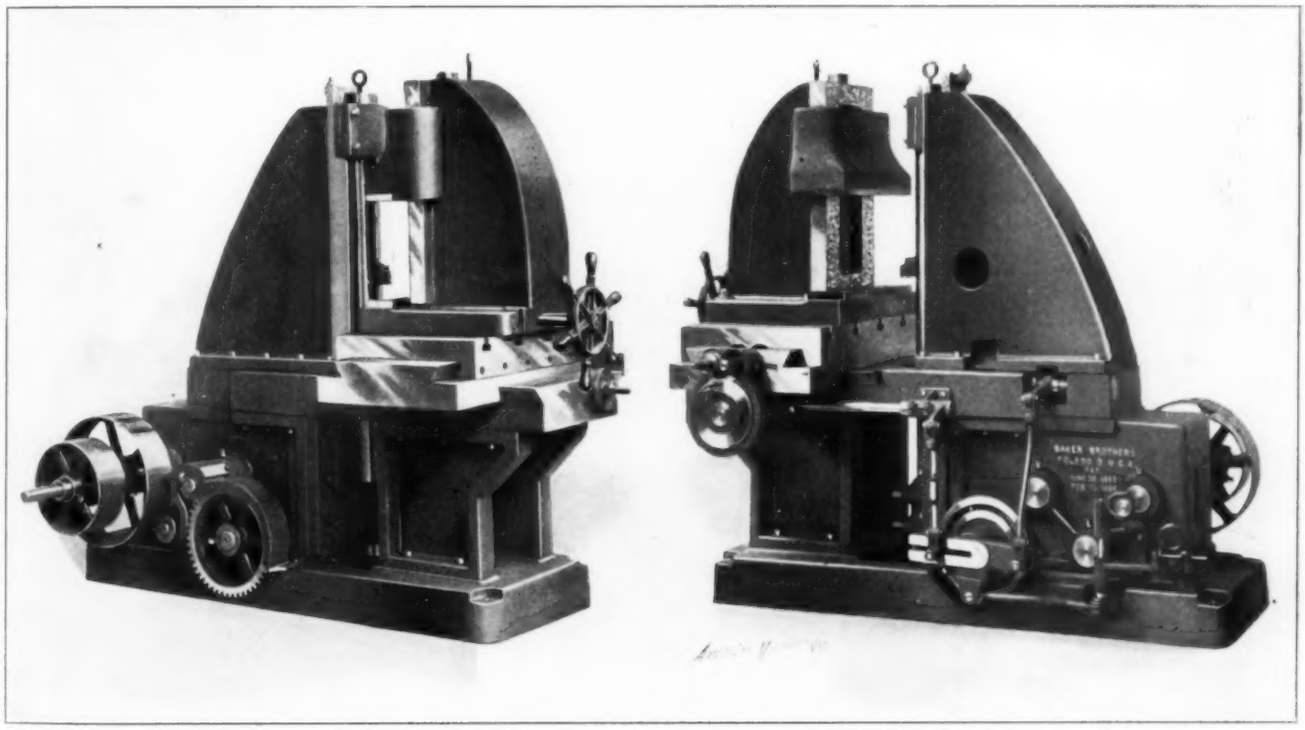


FIG. 2. BELT-DRIVEN SHAPER.

operated by a screw 2¾ inches in diameter. This screw is rotated by means of a worm and gear, the pilot wheel for turning the worm being located at the front of the machine within convenient reach of the operator.

Each machine has a table measuring 24x40 inches. This table has a transverse movement of 24 inches with power feed, and a hand feed to and from the cutter of 14 inches. The working stroke of the cutter-bar is 16 inches; thus it is possible to machine a surface 16x24 inches at one setting. The cutter bars are of steel, 5 inches in diameter, and carry cutters made from 2½x1½-inch stock.

FIG. 1. CATALOG FILE.

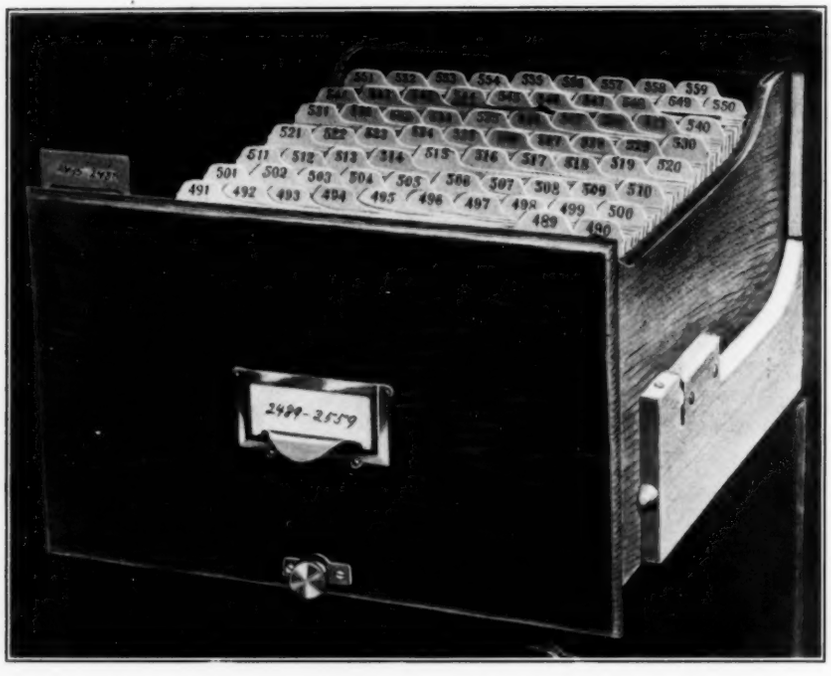


FIG. 2. ARRANGEMENT OF CATALOGS AND GUIDE CARDS.

Catalog File.

The AMERICAN MACHINIST and POWER receive a great many trade catalogs, and the problem of filing these to occupy the minimum of space and at the same time so that they will be readily accessible and the information they contain easily made use of, has been solved in a manner that may be of interest to our readers. The accompanying illustrations show the principal features of the system.

HILL PUBLISHING CO.
CATALOG FILE.

No. .....

Received ..... 190.....

To be returned to file by office boys wherever and whenever found.

9 x 12 catalogs are numbered from 1 to 1999.
6 x 9 from 2000 to 4999. 4¾ x 6 from 5000.

Notice in No. ..... of .....

190.....

FIG. 3. SLIP ATTACHED TO EACH CATALOG.

The half-tone, Fig. 1, shows the sectional file, each section containing a number of drawers. There are three sizes of drawers to accommodate the various sizes of catalogs, the small drawers at the upper right-hand corner of the file holding the card index, by means of which any catalog is immediately located.

The novel feature of this system is the arrangement of the guide cards. Each

catalog is filed behind a card that is held in its box by the rod shown, and is movable only on the rod. Fig. 2 shows the manner i which these cards are placed in the drawer, the number on each card being plainly visible. These guide cards form, practically, movable partitions between which the catalogs are placed, and as one drawer is filled the filing is continued in the next. Thus the system can be extended indefinitely. No attempt is made to classify the catalogs by subjects or to keep in one place the various catalogs of one firm, each catalog being filed according to its size and in the order in which it is received. For each size of catalog certain numbers are reserved; the numbers for the large size run from 1 to 1,999; for the intermediate size from 2,000 to 4,999; and for the small size, from 5,000 up. As each catalog is received a slip, shown in Fig. 3, is pasted on the cover. On this slip is written the date of receipt and a number corresponding to the number of the first idle guide card in the drawer which holds that particular size of catalog. The numbers of the first and last catalogs in the drawer are put on the ticket on the outside. In Fig. 2 this ticket is marked 2,489-2,559. In numbering the guide cards the first figure is left off, the card numbers running from 489 to 559; thus unnecessary crowding of the figures is avoided.

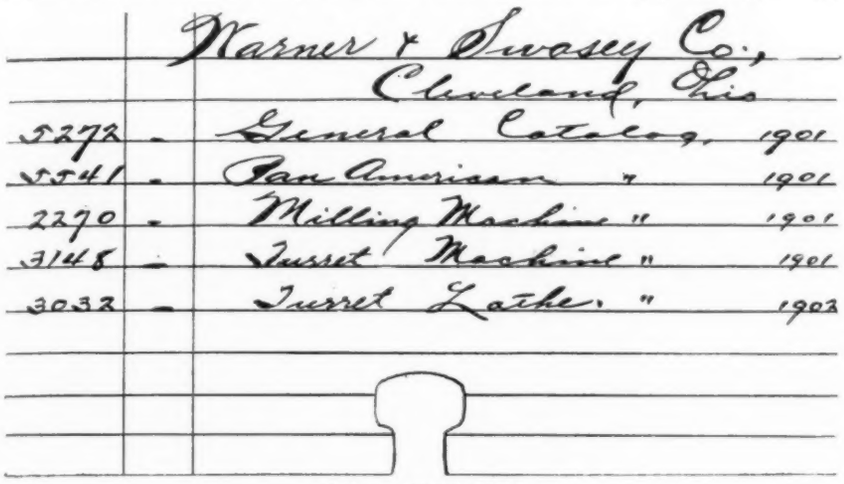

Warner & Swasey Co.,
Cleveland, Ohio
5272 - General Catalog, 1901
5541 - Pan American " 1901
2270 - Milling Machine " 1901
3148 - Turret Machine " 1901
3032 - Turret Lathe, " 1902

FIG. 4. INDEX CARD.

One of the index cards is shown in Fig. 4; each manufacturer has a separate card, on which is noted each catalog as received, along with its file number.

If the Warner & Swasey general catalog is wanted, the card shows its number to be 5,272. All numbers above 5,000 being reserved for small sizes, it is known at once that this catalog is in a small drawer with guide card 272. There is also an index in which the names of various makers of the same machine or article are placed on one card, the card being headed with the name of the article manufactured.

When a catalog superseding one on file is received, the old one is removed and its place and number given to the new copy, the date on the index card being changed to suit.

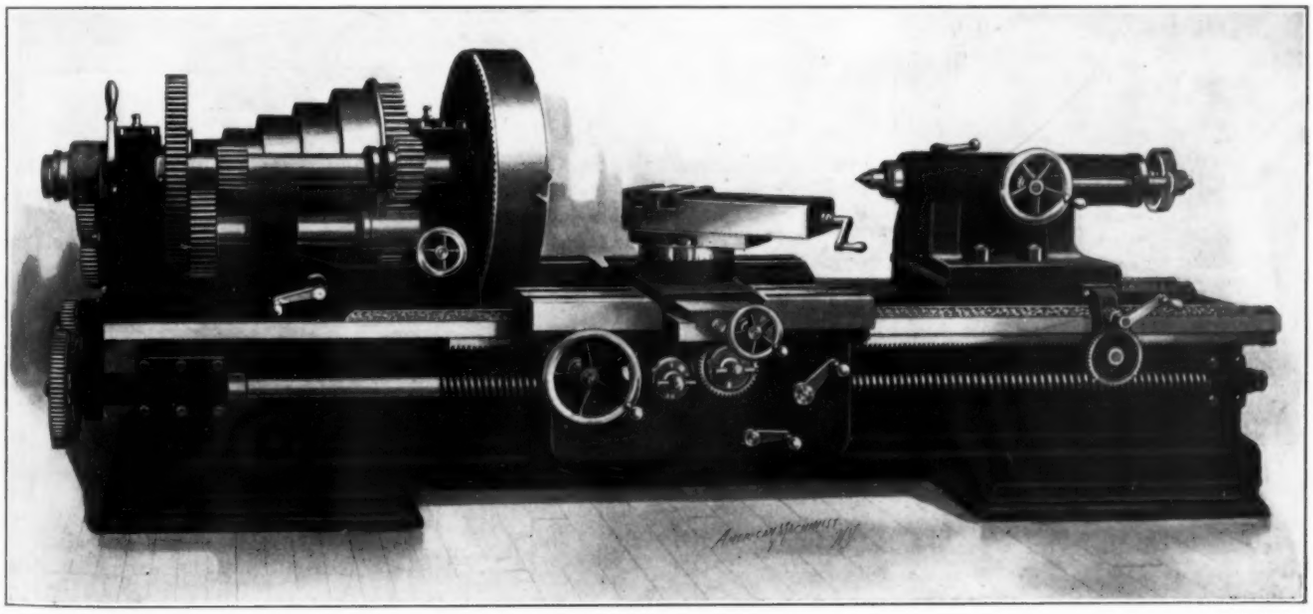
Very thin circulars or bulletins that cannot well be filed separately are classified and placed in envelopes, each envelope being filed as if it were a catalog.

This system prevents duplication. It insures the preservation of *the last* catalog of a firm. It prevents all searching through piles or on shelves for certain catalogs too thin to mark on the back. It prevents a catalog from going back into the file, except in its own place. It admits of indexing by firm name and by articles made, with the least writing, and it keeps the catalogs always clean.

In this office there is a steady stream of correspondence from people all over the world who want to know who makes this, that or the other machine, tool or material, and one man does nothing else but care for this file and answer this correspondence. In a manufacturing plant where a few hundred catalogs at most are used, three sections, one of each size, with, say, four card drawers, would be ample. If more are needed it is easy to extend the case in either way by the addition of any size.

Forty-two Inch Engine Lathe.

The half-tone shows a 42-inch lathe built by the W. P. Davis Machine Company, of Rochester, N. Y.



42-INCH ENGINE LATHE.

This lathe, it will be noticed, has a very powerful drive—the manner in which the spindle is geared being clearly shown in the illustration. The driving cone, which takes a 5-inch belt, has five teps, the largest being 24 inches in diameter. The tailstock is of the German pattern, being cut away in front. The feed is reversed

in the apron and can be changed instantly. Four changes of feed are obtained by moving the lever at the front of the headstock; thus a very heavy or light chip can be taken at the will of the operator. The compound rest can be fed out 7 inches beyond the face of the carriage, thus getting the benefit of the full swing of the lathe. This lathe weighs, with 16-foot bed, about 19,000 pounds.

Variable Speed Device.

We illustrate herewith a variable speed device made by Geo. Richards & Co., of Broadheath, near Manchester, England.

Fig. 1 shows the device, and Fig. 2 a boring mill with the device attached for driving the feed mechanism. The arrangement of the gearing is shown in Fig. 3. On driving shaft *A* are secured four spur gears. Shaft *B* above also has four gears fast upon it. A frame or box *C*, which is mounted in such a way that it may be turned by handle *D*, carries four intermediate gears which mesh with the driving gear on shaft *A*. As frame *C* is turned, any one of the driving gears may

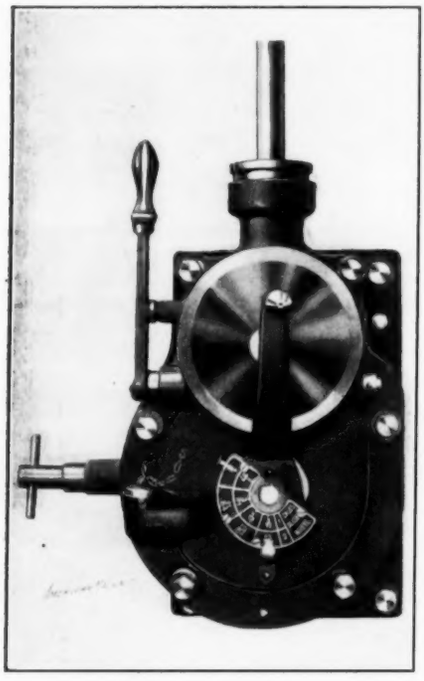


FIG. 1. VARIABLE SPEED DEVICE.

be connected—by means of its intermediate—with its mate on shaft *B*. The index plate on handle *D* shows how far it should be turned to obtain a certain feed, and when the gears are properly in mesh a spring pin *E* drops into a hole in the frame and locks it in position. The vertical shaft *F*, operating the feed, can be driven in either direction by means of the bevel gears and clutch on shaft *B*, the clutch being moved by a lever shown in Fig. 1 at the left of the shaft. Shaft *B* can, if desired, be extended and used as a connection in place of the vertical shaft *F*.

A Monkey-Wrench Story.

A Canadian friend sends us a monkey-wrench story, the source of which is unknown to us, but it is worth reprinting. It is introduced as coming from the Pincher Creek district. Two travelers were driving through that section and met with an accident to their buggy. One of the two went to a near-by shanty, the occupant of which happened to be a Swede, and asked if he had a monkey-wrench. The astonished traveler received the following reply:

"No, Ay got a cattle ranch; may brother Ole, haf a horse ranch; Nel's Nelson haf a hog ranch ba de crick ofer; and a Yankee feller haf a sheep ranch but five mile down the road; but Ay bet no feller fool enough to start a monkey ranch in dose country."

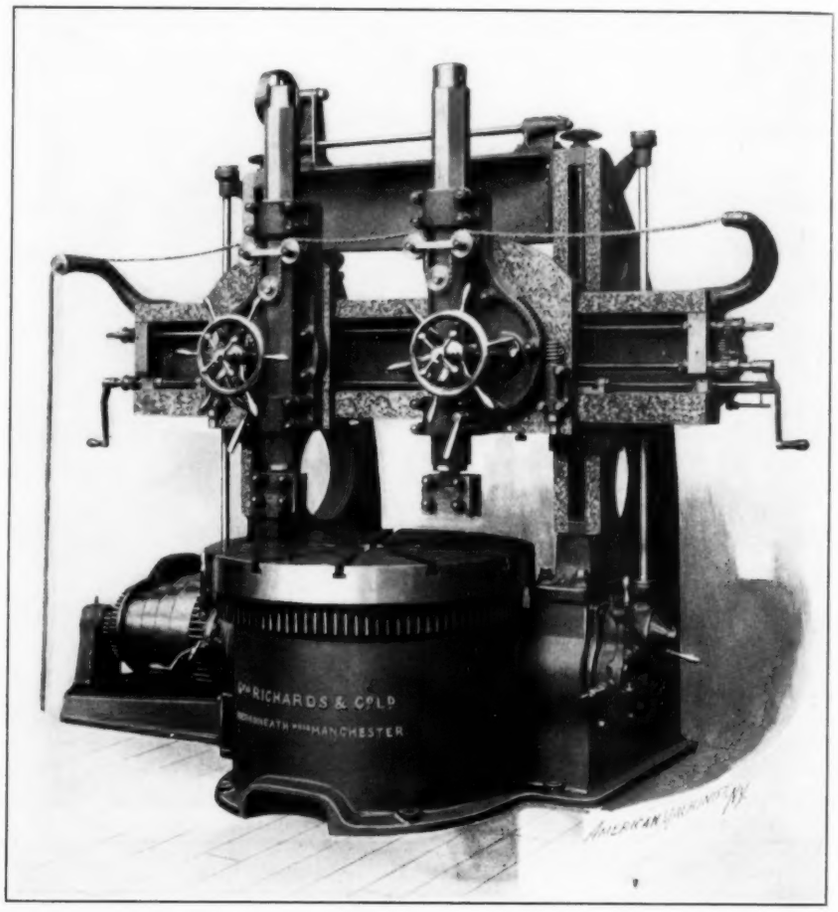


FIG. 2. VARIABLE SPEED DEVICE DRIVING FEED.

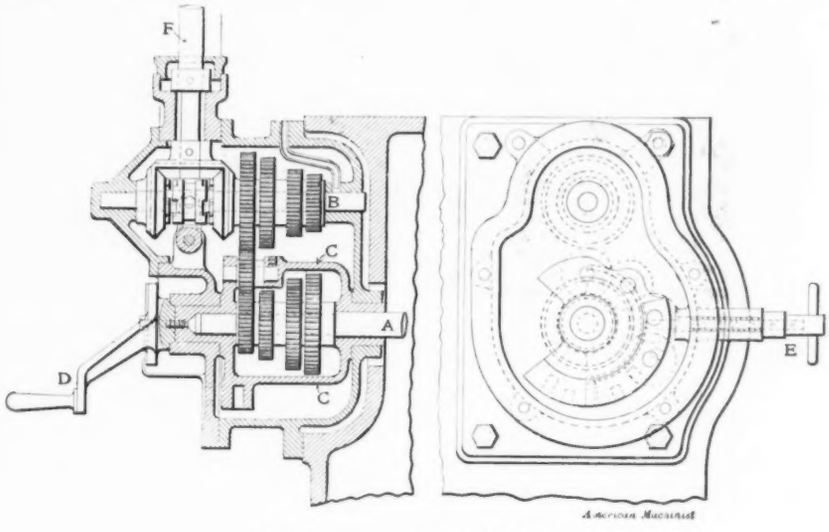


FIG. 3. VARIABLE SPEED DEVICE.

Notes by a Wandering Mechanic.

ASSEMBLING AND INSPECTING LATHES—INSPECTOR'S REPORT—SCREW LIST FOR ASSEMBLING GANGS—SPINDLE DRILLS—HEADSTOCK BORING FIXTURE—SPLINED ROD MILLING ATTACHMENT.

BY H. GOLDSMITH.

While working in the shop one day in March, 1899, I began to think about my future prospects. I had been with the firm four years and felt familiar with its manufacturing methods. As these people, of course, did not know it all, it seemed to me I could broaden my experience and better fit myself for future opportunities by starting out to wander from city to city, working for some of the well-known machine builders and learning something of their shop systems. After due consideration I left my position and started out to satisfy my ambition.

The experiences related here extend over a period of nearly three years. During this time I was roaming from Cincinnati, Ohio, to Hartford, Conn., stopping at all the large cities, managing to find a job in each place and making enough money to pay my board bill, take me into the different places of amusement, and

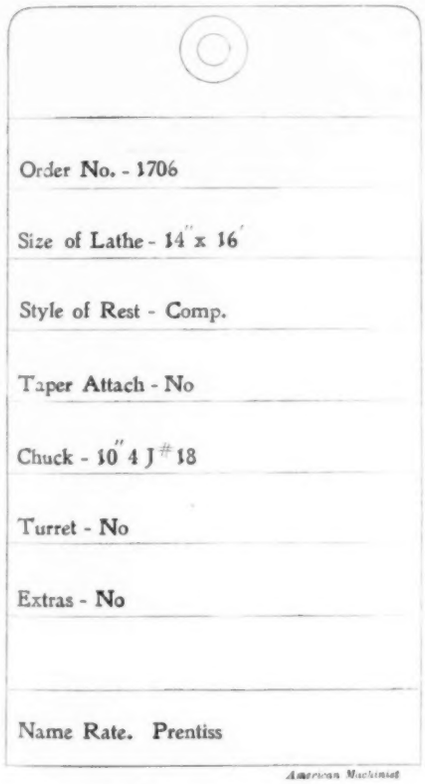

Order No. - 1706
Size of Lathe - 14" x 16'
Style of Rest - Comp.
Taper Attach - No
Chuck - 10" 4 J # 18
Turret - No
Extras - No
Name Rate. Prentiss
American Machinist

FIG. 1. LATHE TAG.

carry me to the next town. The various shop methods and special devices which I ran across on this trip and shall describe here may be old to some, but to me were entirely new.

The first shops entered were those of the Lodge & Shipley Company, of Cincinnati, O., who make a specialty of engine lathes. These shops are ideal in their construction, being light and airy and arranged on the one-floor plan, with crane passage way in the center. All erecting is done in this passage way, which is 330 feet long by 60 feet wide. Here the large beds are strung out side by side and the small parts are erected and alined on the same. Three electrically driven cranes with pneumatic hoists attached, operate in this passage. In the assembling department, which is at one side, all of the details pertaining to the lathe, such as the headstock, tailstock, apron, carriage, compound rest, etc., are completed. These are all put together ready to be sent to the main aisle, where the lathes are erected. In the grinding department great attention is given to the spindles, apron studs, etc., everything being worked to standard sizes. All parts that require drilling and tapping are handled in jigs; in this manner the entire machine is built on the interchangeable plan. What struck me as being a clever idea to assist the foreman and erecting gang was the tagging of the lathe beds in course of construction. This tag (see Fig. 1) shows at a glance just what is wanted to fill the order on that machine. The foreman and shipping clerk, being provided with duplicates, always have at hand a list of the orders that are in the shop and know which orders require immediate attention.

In this shop more care was expended in taking care of the many different styles and sizes of screws than in any other shop that I had been in. Fig. 2 shows one of the screw lists. The gang building headstocks had one list, and the gang in charge of aprons had another—each separate crew, in fact, having a list covering everything pertaining to the work. If a lot of 14-inch lathe headstocks were being assembled and the front cap screws were wanted, it would be seen by looking at the list, under headstocks and in the 14-inch column, that four No. 45 screws were required for each headstock. These screws were obtained from the stockroom by giving the list number and stating the quantity needed. This system worked admirably and should be adopted in other shops.

		14"	16"	18"	20"	22"	24"	28"	30"
Head Stock	Front Cap	4 #45	4 #60	4 #30	4 #85	4 #90	4 #95		
	Back Cap	2 #45	2 #60	2 #30	2 #85	2 #90			
	Front Screws-Bed	2 #75	2 #40	2 #45	2 #70				
	Back Screws-Bed	2 #35	2 #32	2 #38					
	Quadrant	1 #24	1 #20	1 #25	1 #31	2 #28			
	Patent Oil Hole Covers	2 #1	2 #1	2 #2	2 #2	2 #3			
	Face Gear Lock Nut Screw	1 #7	1 #7	1 #9	1 #9	1 #11			
	Cone Pulley Oil Hole Screw	2 100	2 #100	2 #100	2 #102	2 #102			
	B.G. Oil Hole Screw	2 #100	2 #100	2 #100	2 #102				
	B.G. Bushing Screw								
Tail Stock	Clamp Bolts								
	Set Over Screw								
	Eccentric Screw								
Apron									

American Machinist

FIG. 2. SCREW LIST.

A very good spindle drill used by this firm was of the inserted cutter type with stepped cutting edges to break up the chips. This proved far superior to any type of drill that they had previously used in making their spindles. This drill is shown in Fig. 3.

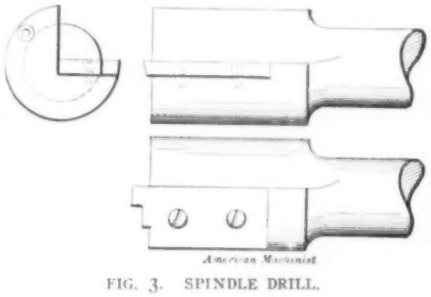


FIG. 3. SPINDLE DRILL.

The writer caught the wandering fever again and wanted to be off on his "hobo" trip, but before he had started some milling operations were introduced to do away with some of the shaper and planer work. Maybe those "buckeyes" didn't open their eyes as wide as saucers to see how the time was cut down with gang cutters and end mills.

The next firm on my list was the Amer-

ican Tool Works Company, of the same city, and I had no difficulty in getting a position at their place. I found they had a number of shops and divided their work accordingly. For instance, large lathes

LATHE REPORT

Order No. 4798 Size of Lathe 30" x 10'

Shipped to _____ Date 1-10-1899

Head Stock Tested with 18" Bar

Top Alignment		Side Alignment	
Up .001"		To Front .001"	
Down		To Rear	
Taper Hole in Spindle Runs Out		.0005"	True

Bores in 12 Inches

Large	In Front / In Rear	True	yes

Face Plate

Hollow	.001"	Rounding	

Tail Stock

Top	Up / Down	.0005"	Side	Front / Rear	.001"

Remarks _____

All parts inspected and found in good condition

_____ Inspector

Passed by _____

Chief Inspector Jan. 11-1899

American Machinist

FIG. 4. INSPECTOR'S REPORT.

from 20 to 64-inch swing, heavy planers and radial drills were built in Shop No. 1; small lathes, in shop No. 2; small drills and small radials, in shop No. 3, etc. Each shop had its own superintendent and foremen, and over the the entire plant was one general superintendent. This system for handling their different departme ts worked with perfect harmony. All detail parts had to pass through an inspection department, where they were checked up with the drawings, gaged and, if passed, stamped with the inspector's initials. The greatest inaccuracy allowed was .001/2 inch, and in assembling these parts went together like clockwork. After a machine was assembled, before it could be shipped from the shop it had to go through a certain course of inspection. The results were noted on sheets arranged specially for the purpose, the sheets being filed away for future reference. This inspector's report is shown in Fig. 4. This firm used a spindle drill which made a hole that was as smooth as glass. The drill is shown in Fig. 5, and it will be noticed that the cutting edge is about .007 inch above the center. Naturally the tendency in boring is to force the cutting edge down to the center, resulting in a burnishing action in the bore of the spindle. Quite a number of floor stands for headstocks and tailstocks were used about the place, and some of them were fitted with tilting tables. A very good fixture made there for boring headstocks and tailstocks is shown in Fig. 6; it is used on the table of a boring machine. The base of this fixture has a pair of V's planed to fit the headstock or tailstock templet. Two uprights *A A*, secured to the base, are bored out and bushed to suit the boring bar. This bar is provided with two slots for cutters, so that both headstock spindle bearings may be bored at once. The taper shank *C* fits in the spindle of the boring machine and drives the bar by means of two universal joints.

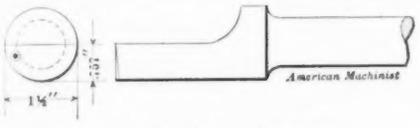


FIG. 5. ANOTHER SPINDLE DRILL.

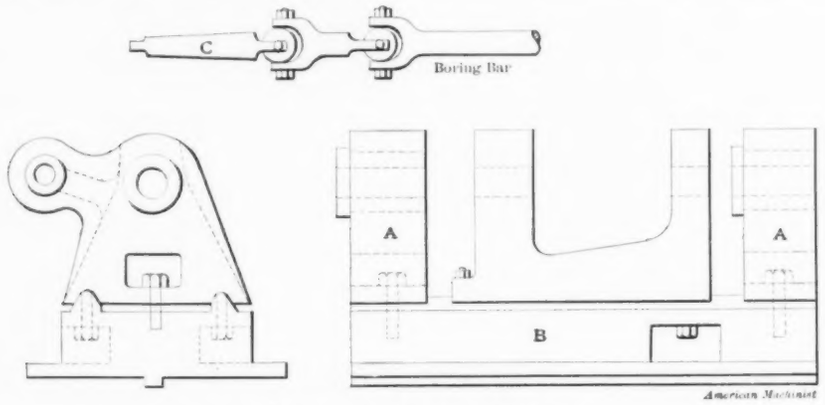


FIG. 6. FIXTURE FOR BORING HEADSTOCK.

The usefulness of such a boring fixture is apparent; the bearings in all headstocks and tailstocks will be located alike and bored out true with the V's, regardless of the condition of the boring machine in which the fixture is used. The milling department in this shop was worked right up to the limit. Some good specimens of milling work can be seen on their lathe aprons, headstocks, caps, compound rests, bevel-gear stands and other parts.

By the way, I almost forgot to tell you about the splined rod milling attachment fitted to a No. 0 milling machine and cutting something like 20 inches per minute. Fig. 7 shows this attachment. Cone pulley *F* is driven direct from the cone pulley on the spindle of the milling machine, and is keyed to a shaft driving the worm *D*. This in turn drives the worm-wheel and gear *A*, which are keyed together. Gear *A* transmits motion to gear *G* rotating the studs *E* and cones *B*. The upper cones have a vertical adjustment on splined studs *E*. These cones are forced down by the nuts *N* and feed the rod under the cutter and into the rest *L*. This steady-rest carries a plate *K* fitted with a tongue and this tongue enters the keyway and keeps the rod from turning as it is fed forward.

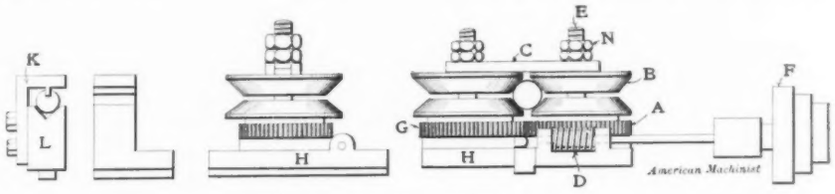
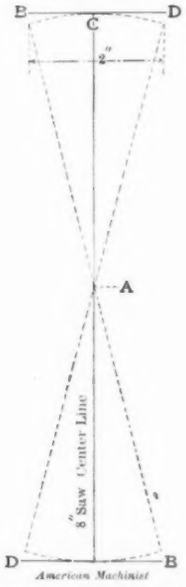


FIG. 7. SPLINED ROD MILLING FIXTURE.

Action of a Wobbling Saw.

A writer in *The Wood Worker* offers the sketch here reproduced and asks why a wabbling saw will cut a flat-bottomed groove. We can only ask, will it? The writer asserts that a perfectly round saw 8 inches in diameter was set to cut a groove 2 inches wide and that the bottom of the groove was perfectly flat. The sketch, which is in correct proportion for



THE CUT OF A WABBLING SAW.

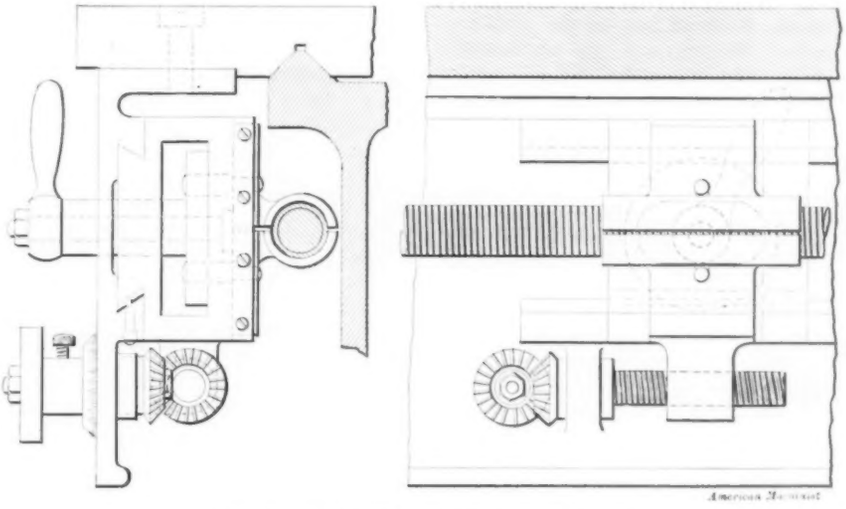
the above figures, shows by the dotted curved line the shape which the bottom of the groove should have.

Some Guns from China.

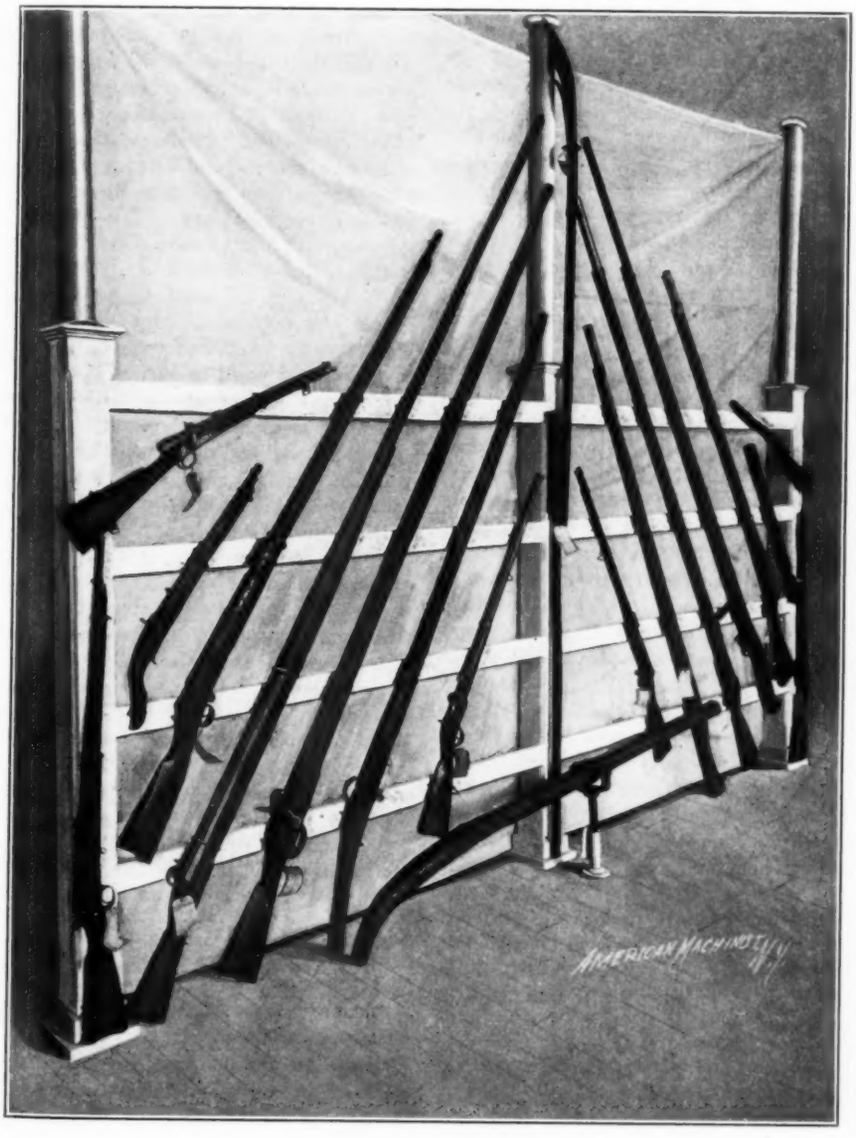
The photograph shows some guns which were obtained by an army officer during the recent military operations in China and were sent to this country. They have been installed as shown in the Springfield Armory at Springfield, Mass., where the photograph was taken. They will be seen to include some arms of modern construction and also some of very ancient origin. We know very little about them beyond this, as we have been unable to secure detailed information regarding them. They form, however, an interesting collection, owing to the way in which it was obtained if for no other reason.

A Lathe Attachment for Side Adjustment of the Cutting Tool.

The cut shows a lathe device which should be valuable for certain lines of work. It is not properly an "attachment," as it cannot well be attached, but must be incorporated in the design and construction of the lathe. The cut shows an end view and a view of the inside of the apron. The nut which clasps the lead screw is mounted upon a sliding piece which has a limited longitudinal movement in the apron and is held rigidly or moved as required by the short fine-threaded screw below. This screw is shouldered in both directions by the hub in which it turns and which is a part of the apron. A miter gear on the end of the screw meshes with another on a spindle which passes out through the apron with a hand wheel on the end outside. Close to the apron on the same spindle is a graduated disk which registers in thousandths of an inch, or other minute units, the movement of the nut in either direction. When the nut is clasped to the screw the movement is really a reverse movement of the carriage and the tool which it carries relatively to the thread of the screw. The use of the device is obvious. If the tool is adjusted for cutting a thread the turning of the wheel will move the tool to one side or the other. If a new tool has to be set this movement may be used to give it the correct lateral adjustment. In plain turning the same may be used in many cases, as where facing a shoulder where it is required to take off an additional measured amount. The device is the invention of H. T. Shearer, Waynesboro, Pa., and is patented.



LATHE ATTACHMENT FOR SIDE ADJUSTMENT.



SOME GUNS FROM CHINA.

The electricians would seem to have little to fear from the competition of acetylene for lighting. The *Electrical Review* gives the following figures: A ton of calcium carbide requires 4,500 kilowatt-hours of energy for its manufacture and gives 10,000 cubic feet of acetylene. In burning, this gas gives out 250,000 candle-hours of light. The same amount of energy would produce 1,440,000 candle-hours if consumed in incandescent lamps, about twice as much if used in Nernst lamps, and nearly five million candle-hours if used in working open-arc lamps.

The Flat Drill as a Turning Tool.

BY F. W. SHAW.

On page 195 of the present volume is a description of flat drills and appliances as used in England, the writer of the same correcting or commenting upon an article appearing on page 1353 of the preceding volume. Now, in my opinion—and experience has confirmed it—there is too much back taper in those drills illustrated on page 195, making it impossible to grind them often without having also to visit the blacksmith frequently to have them drawn out. Except in the first, or roughing drill, there should be as little back rake as possible, not only for the reason stated, but to keep the hole true. Much rake will allow the drill to dodge more or less sidewise into porous parts or blow-holes. Fig. 1 shows the improved roughing drill, which should only be used to take off the sandy and scaly surface. An oblique lipped drill like this tends, by reason of the angular edges, to follow the cored hole, no matter how much weight is placed on the steadying lever. I might say here that it is not always necessary to weight the lever, except by a gentle pressure of the hand. Drill Fig. 2 also is a roughing drill and is ground to cut at the end, the corners being only slightly rounded—a sharp corner soon goes. This drill should be parallel on the sides, or, if anything, with only a few thousandths back rake or clearance per inch of cutting edge. It is impossible to drill a deep hole perfectly true unless it is guided—as by the pieces of hard wood screwed on as shown by Fig. 3. Fig. 4 shows the pressing or steadying lever. To start a hole, set the drill on the tailstock center, put on the steady lever, weight it, start the lathe and feed slowly until the drill has a steady motion. On a pulley lathe the tailstock has a ratchet feed, and a man attends to two or more lathes, turning one pulley while another is being bored, and they get them out very rapidly; so rapidly, in fact, that it is difficult to persuade pulley makers to put in boring mills.

The best way to make these drills, and the only way for best work, is to forge the ends over size and turn them. Harden and grind them up in the machine grinder, allowing slightly more, to avoid boring above size, than would be allowed in the case of a twist drill.

I know several tool shops in Halifax, England, where a twist drill is never seen, shops turning out lathes up to 24-inch swing and drilling machines up to 36 inches. They seldom trouble to fix the hardwood blocks on the sides of the flat drills either, and the result is that after boring, say, a cone pulley having a long hole, it is necessary to file the high places which appear opposite blow-holes. Of course they could make a decent job if they left 1-64 inch and used a reamer, but reamers are too expensive (?), as also are the twist drills.

I had related to me a fine case of cutting down expenses in a tool shop in the same town. A certain firm every month turned out six machines, selling at about £45 apiece. Although there were many small parts which could be made and stocked without having much capital lying idle, they persisted in making every part, even to the smallest collar or set-screw, separately for each machine. The reason for so doing was that they could then check the cost of each machine. In course of time they found out exactly the average cost, and whenever after sending out a machine and balancing up the total showed a greater cost than the average, they had the foreman up for an explanation. "This machine has cost 30 shillings more than the last; how is it?" "Oh, the so-and-so casting was hard; it took Jim two hours extra to plane it, and Tom had all his work set out to do. The scraping in took three hours extra time," and so on. "Oh, that's it, is it? We'll have to knock it off the ironfounder's account." And they did so, too. The foreman asked many a time if he couldn't make a few extra of this or that, but "No!"

If these drills are hardened by plunging while hot into water and let down to straw color in such a manner that the center part *a*, Fig. 2, as shown by the dotted lines, is drawn as soft as possible, the width of the drill can be expanded to take up wear by lightly hammering this same soft central part. A light tap or two will do the trick and save a heap of trouble in making new drills. To let the central part down below the cutting edges in temper, simply dip the cutting edges in water to keep them cool while the temper is drawing.

To the best of my belief, the flat drill had not been used as a general turning tool, as hereafter described, until I used it myself; in fact, I have never even since seen this method of turning employed. Various tests of the drill on this capacity have led me to the conclusion that there is a great field here for development.

At one time it fell to my lot to have to bore, counterbore, face and turn the bosses of a quantity of face-plates, catch (driver) plates, chuck backs, and the like. The castings were chucked by the ordinary four-jaw independent chuck (a self-centering one would have been better, but we didn't happen to have one), and it was my original custom to attack them by boring with the flat drill in the manner already described, afterward taking out the drill holder from the tool-post, fixing a boring tool to counterbore the hole, taking this out to replace by a roughing tool to face the boss, in turn replacing the roughing tool by side round-nose tool to turn the boss. By this method many changes were necessary to complete the job, and each change was such as to occupy quite a long time, compared with the changing of the flat drills in the following method of doing the same work.

Fig. 6 shows one of the afore-mentioned castings being bored by a flat drill fed up by the tailstock, supported by the tool holder *a* and steadied by *b* with a weight attached. The counterboring is accomplished by presenting a square-lipped drill to the side of the bore, the cross-slide being fed forward to cause the back of the slot in the holder *a* to butt against the back edge of the drill, to prevent it springing back. For shallow counterbores, the cut may be put on by feeding the tailstock center up, and sliding across by feeding the cross-slide screw.

Fig. 9 shows the method of facing the boss, feeding across by means of the cross-slide screw. This method will make a slightly hollow face, but not so much so as would at first be imagined, as, while the drill is apparently traveling in a circular path, by reason of the drill being swung on a conical point the cutting edge is also advancing toward the work, partially negativing the circular movement. If then the drill is long compared with the diameter of the work, the error will be inappreciable.

Fig. 10 is a turning tool being used for turning the boss. This also is fed up by the tailstock, and it will be noticed in this case that the tool bears at the front of the slot in the drill holder. Figs. 11 and 12 show methods of undercutting, the same tackle being used. In cases where tools of special formation or delicacy are used it is necessary to first take the scale off with less expensive ones.

Figs. 13, 14 and 15 show forms of tool-holders. Fig. 13 is the common or "garden" one, and the most useful if made correctly as regards the hight of the slot. Fig. 14 is for use when tools are needed having ends formed in such a shape that they cannot be passed through the slot. The pin *a* is used only when it is needed to feed the tool forward, as in Figs. 7 and 9. Fig. 15 is an adjustable (for hight) holder suitable for a shop having need to use it on different lathes.

It is difficult to give credence to the statement that the amount of work that can be turned out with this apparently rude tackle can compare with that on a first-class capstan (turret) lathe. To give an example, however, that comparison can be made, take the casting shown in Fig. 16. These castings were bored (roughing and finishing cuts) and faced at *a*, *b* and *c* with these flat tools, no fixed tools being used, at the rate of 100 per day (ten hours), and all were made to gage. By the improved method shown in Figs. 17, 18 and 19, a gain of twenty per day resulted and a rather better job was made. I believe I am not far wrong in stating that this performance could scarcely be reached on the turret lathe. It will be remembered that, owing to the comparative hardness of our castings here, a turret lathe is not capable of being used to advantage on this class of work unless facing cuts can be taken. To make an equal job

of these to hand work would require more tools than the turret would be capable of carrying. It is necessary to note that to work to gage it is advisable to employ similar stops on the bed, cross-slide, etc., as are detailed on Figs. 17, 18 and 19.

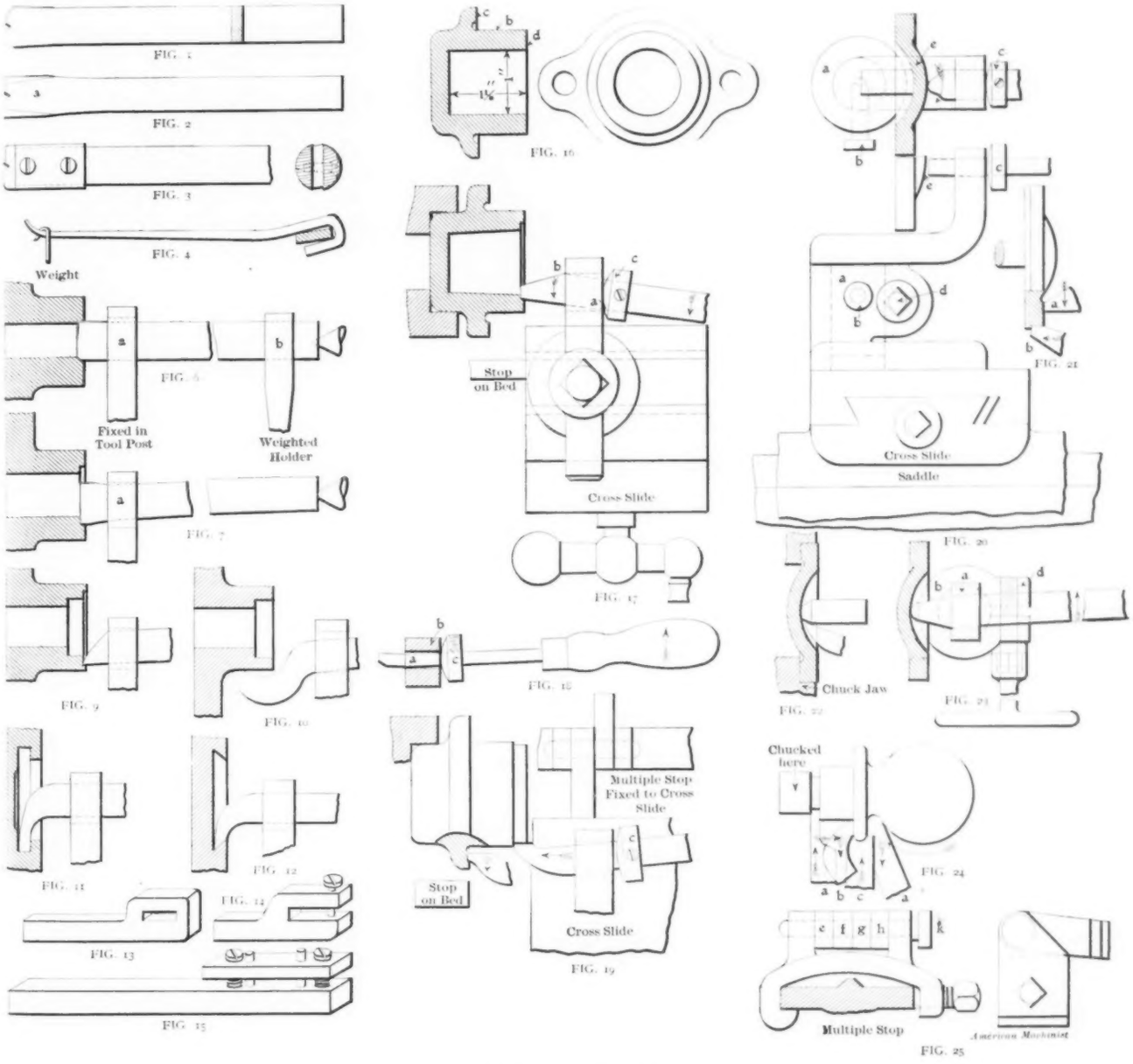
After some experience with the method just described, we were led to simplify it in some classes of work by the adoption of handled tools, as Fig. 18, somewhat of the nature of scrapers, but with a positive instead of a negative top rake.

In this case the movements of the tool are obtained by means of the compound slides of the rest and the saddle, the tail-stock being only employed for feeding the flat drills used in boring. The tools not being held to their work mechanically, we depended upon the friction induced by firmly pressing the tools against the edges of the slot, as shown in Fig. 17 at *a* and *b*, and against the top and bottom of the slot as at *a* and *b*, Fig. 18. The arrows on the handle and shank of the tool show the direction in which pressure is applied to bind the tools in position. Referring to Fig. 17, the tool is pressed into position up to the stop *c*, and then fed to its work by a movement of the saddle along the bed. The first cut is taken at a slow lathe speed, the saddle fed to a stop fixed on the bed. The tool is then replaced by a finishing tool of the same shape.

Fig. 19 shows the outside of a boss and the inner face of a flange being faced, the arrows denoting the feed directions obtained by the cross-slide and saddle, either actuated by hand or by automatic traverse by the back shaft or splined front shaft, as the case may be. It is well to rough out by hand traversing and to finish by mechanical traversing of the slides. In many cases, to save tool adjustment, or a long projecting tool, it is advisable to have what I have termed multiple stops, as shown at Figs. 19 and 25, fixed to the cross-slide and bed. The use of these will be self-evident.

So far we have treated only of straight work, but I have found the same methods available for circular formed work, as at Figs. 20 and 24. For this purpose the top slide is taken away and replaced by a socket *a*, Fig. 20, which shows plan and elevation of the same. The tool-holder in this case is provided with a shank to fit into the socket and capable of being fixed in position by the pin *b*, or clamped by the square-headed screw *d*. To assist in the speedy execution of the work, a key is always (unless in the way) kept in position.

To show the *modus operandi*, I have shown a cylinder cover which is made in this country for model engine work and is machined all over. The casting is chucked



THE FLAT DRILL AS A TURNING TOOL.

by means of the stem shown on the back, and the rounding face *e* is turned by a tool fixed in the holder as shown, a swiveling motion being given to the holder by pressure on the handle of the tool. If the center of the socket is placed in the correct position, the right sweep is obtained. Interchangeability is guaranteed by correctly placing the tool stops. In each operation two cuts, roughing and finishing, are taken at slow and quick speeds respectively. At *a* and *b*, Fig. 21, the operations of facing are seen, movements in the direction of the arrows being obtained again by the saddle and cross-slide. In this case the multiple stops will be brought into operation, and after the circular cut is made, the pin *b* will locate the position of the socket, so that the outside and face cuts may be correctly made with the aid of the stops.

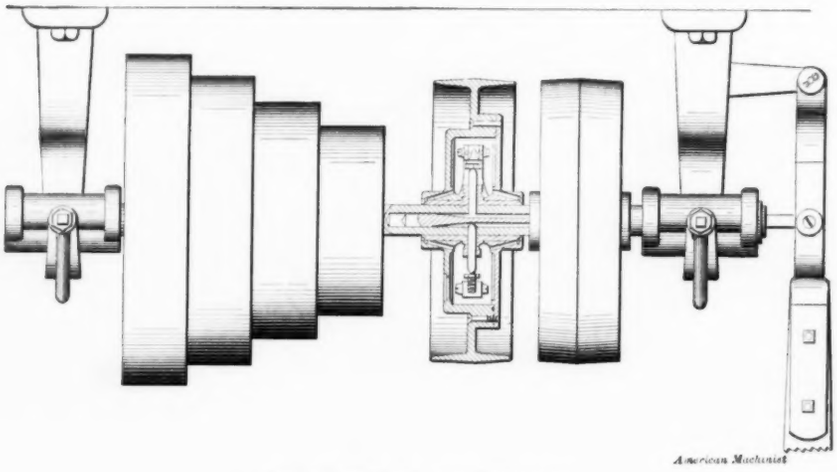


FIG. 1. FRICTION COUNTERSHAFT.

To machine the back and inside curved surface, the articles are rechucked in a self-centering chuck, as at Fig. 22, and the stem is nicked and broken off by a hand tool fixed in tool-holder *a* in socket *b*. This socket, it will be noticed, now has its center to the right of the casting, by reason of the curve being the reverse of the outside curve. Fig. 22 shows the tool in operation cutting out the concave side by a sweep of the handle in the direction of the arrow. After taking the circular cuts, it is necessary to insert the knurled pin to locate the socket correctly, so that further operations can be performed in such a manner that the stops can be used to ensure interchangeability.

Fig. 24 is an ornamental knob, and *a*, *b*, *c* and *d* are the four tools employed for turning it, two of each kind being used, roughing and finishing. The arrows show the direction in which the tools are fed.

Fig. 25 shows the multiple stop fixed to the ways of the lathe bed. *e*, *f*, *g*, *h* are interchangeable stops, which can be made of any length desired. They should be fixed so that (to avoid mistakes) they can be thrown over in the order arranged between the lugs. The pin *k* is knurled for ready removal and replacement. Any adjustments not afforded by these stops can be made by the stops *c* on the tools themselves.

The methods of turning shown in Figs. 16 to 24 are simply developments of the art of scraping and turning by hand tools employed in this country to a vast extent. In textile machinery works it is no uncommon thing for grooved pulleys up to 2 feet in diameter (light pulleys, of course) to be turned by hand, but in all cases the tools are supported upon the tees of a hand rest, a very long handle being used to secure stability and leverage to overcome the "digging in" action of the cut. With the methods described, however, the tension upon a man's muscles will be considerably reduced, as the amount of force necessary to prevent the tools sliding is small compared with that necessary on following the old way.

In soft metal work (brass, etc.) former tools of similar shape can be used. In this, to get the full benefit, the tools should be kept arranged in order ready for the hand, and always put back in their own places. Each tool must be provided with a stop.

It must not be thought that these methods are available only in cases where large quantities are needed; not so; the method shown up to Fig. 19 can be employed on almost any odd job, with gain in time over using fixed tools, and with more gain proportionately than on a larger job; for in many instances on the long jobs the work can be done at several chuckings, to avoid constant tool changes.

Birmingham, England.

Friction Countershaft.

The accompanying illustrations show a friction countershaft made by the Wheaton Machine Company, 368 Congress street, Boston, Mass.

Fig. 1 shows the countershaft complete and Fig. 2 the friction pulley construction. The central hub *A*, which is keyed to the shaft, is turned up to form a bearing for the pulley and for the cover *B* fastened over the circular chamber in the pulley. The gripping dogs or levers *C*—hung at the ends of the arms on hub *A*—are finished at one end to fit the friction surface in the pulley chamber. The countershaft is drilled out to receive the hardened rod *D*, which is connected to the shipper as shown in Fig. 1. As the rod is moved in the shaft by the shipper, a double wedge—formed on the rod—forces out the two pins *E*, and these pins press the gripping levers tight against the friction surface. When the rod is moved in the opposite direction the springs force the pins toward the center and release the levers. A screw plug at the back of the chamber can be removed and the pins *E* adjusted to give the gripping levers the desired pressure. A gasket is put under the cover *B*, making the chamber oil tight. Oil is poured in the chamber and the motion of the pulley carries it to the bearings. An annular groove at the end of each bearing collects any oil that escapes, the oil returning, through holes drilled at an angle, to the central chamber.

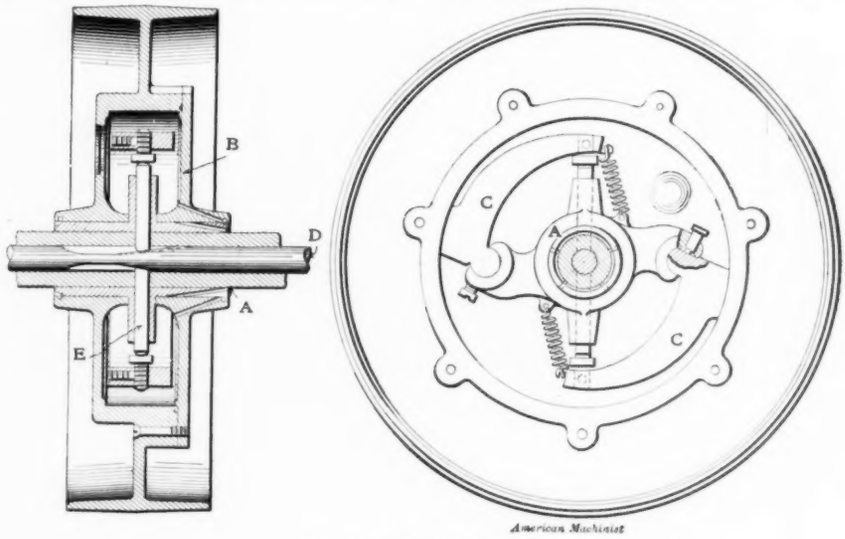
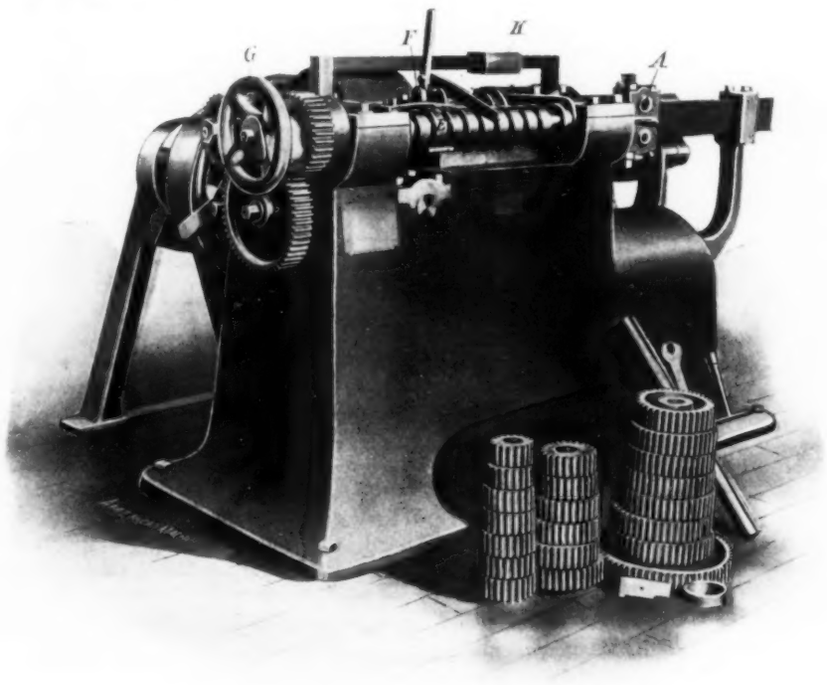


FIG. 2. FRICTION PULLEY.

Spring Coiling Machine.

This machine, which is built for coiling car springs, will handle round, square or other shaped stock. The spindle carrying the mandrel *H*, around which the stock coils, is driven by the shaft at the rear. The lead screw *E*, at the front, is driven by means of change gears from the spindle. A nut *F* operated by the lead screw moves the guide-block *A* shown at the front of bar *D*. The stock taken from the furnace is fed through guide *A* and under dog *B*, a wedge *C* holding the dog down tight on the stock. The stock feeding part way around the mandrel *H* before nut *F* starts the guide, this end of the spring is finished at once. When the spring is nearly wound the nut is thrown out by an adjustable stop *K*, and the end of stock feeding in straight on the mandrel, the tail end of the spring is finished.



SPRING COILING MACHINE.

The roller *I* is then brought up against the spring to close it; the spring is removed and the guide is run back to its original position.

The mandrels are readily changed for different sizes of springs, the change gears of course giving the required spiral.

The countershaft for this machine is driven by open and cross belts, thus making it possible to wind either right or left hand springs. For right-hand coiling the stock is fed through the upper guide in block A, and for left-hand coiling through the lower guide, an extra intermediate gear being used in the latter case. This machine, which will wind stock up to 1⅝ inches in diameter, will coil up to 16 inches in length, making all the usual diameters of coils. The change gears furnished provide for pitches from ½ to 3 inches.

The driving pulley is 18 inches in diameter, 6-inch face, and should run at 150 turns per minute. The weight of the machine is 3,400 pounds. It is made by

SPRING COILING MACHINE.

The Coulter & McKenzie Machine Company, of Bridgeport, Conn. Two other machines for use in connection with spring work are made by this company. One machine is for rolling the taper on the stock before it is coiled, and the other is for testing the finished spring.

Echoes From the Oil Country.

PUTTING A NEW CYLINDER ON THE TANNERY ENGINE.

All the experiences we get on outside jobs are not pleasant ones, although the pleasant ones are the ones that are oftenest looked back to.

I did not design the new cylinder for the tannery engine—I did not know enough to; but I did the floor work in the shop, and I was sent out to put it on. I was told they would be glad to see me, as the tannery had been waiting for some time for that engine which still lacked the cylinder. To judge by the reception I received from the superintendent, I was the sole and entire cause of the delay, and should be severely dealt with because the railroad had not yet delivered the cylinder to them. I was made to feel that my only way was to jump when he moved his jaw or something awful would happen. Before I had been there many hours I saw that I was being treated very nicely indeed—comparatively.

This tannery was on the line of a large railroad, or rather at the meeting point of two railroads. A great many foreigners passed through, and from their ranks most of the help was obtained. A dollar a day seemed to be considered a top price for a day of very laborious work.

The engine I was to put the new cylinder on to had at one time been used by the city of Buffalo, and was very old. It was believed that putting on a new cylinder would result in great economy in the use of steam, as the old one, besides being somewhat light, from the fact that it had been built when lower pressures were used, had also been rebored, possibly several times, and the ports were so designed that the desired cut-off was not obtainable. In the new cylinder these things were

made in more modern ways, and at least one thing was made so far ahead of the most modern that it must be still ahead, at least it is the only one of its kind I ever ran across. The piston head, as near as I remember it, was about 16 inches in diameter and 10 inches long, and was a solid lump of iron.

The man who was responsible for the job came down after I had been there a few days, so as to be there when the engine was started, as he wished to be sure the job was according to his calculations. He was not much given to dress, this mechanical engineer, but was quite a bright man for all that. I was stopping at a boarding house and took him up with me. Of course we talked shop, and without thinking of the landlady, until she remarked to me: "So this man is helping you at the tannery, is he?" "No," I replied, "I am doing the work for him." "Oh, why, I thought—that is now—well, anyways I thought from your looks you were the boss," she replied, evidently somewhat embarrassed by her mistake and looking us over. I am not a dude, and didn't have any Sunday clothes on, either. She evidently wished to show us that she had understood our conversation, if she had gotten our relative positions mixed a little, so she continued, "I am glad you are fixing that engine now; it might have blowed up and killed all the men that work down there, and that would have been awful."

I felt a kick under the table from my companion as he began to choke and cough, while I replied, "It certainly would be terrible to have that engine blow to pieces and kill everyone in the tannery. I never knew an engine to blow as bad as that, though."

My companion had to go outside to finish his coughing spell, and after it was over he came in and gravely tried to explain that it was the boilers, instead of the engines that blow up. The effect his talk had was to evidently confirm the lady in her idea that he was a mild kind of a lunatic. Hadn't she seen engines running on the railroad all her life? After he had put forth his best efforts she remarked, "I am glad you think that perhaps that engine at the tannery wouldn't blow bad enough to blow up and kill the men; but one did up the road a ways once and killed the engineer and fireman and a brakeman, and around a tannery there are more men to get hurt."

On the way back to the tannery I asked why the head was made so heavy, and was told that it was to keep down the strains on the crosshead pin, crank pin, etc.; that, as the engine was so light that it pounded under the former conditions, it would be much worse under the increased pressure of steam that it was proposed to carry. He expressed regret that the design of the engine did not permit him to put an extra ton of metal in the crosshead. I asked how the head would be for wearing the cylinder, but he quickly demonstrated by figures that, even allowing for the space removed for the rings, the pressure would not be excessive. I never learned how that head and cylinder got along together, but I have always had a lurking prejudice against having any more weight in a piston head than strength called for.

Among the other new things on this engine it was designed to use some asbestos packing, which was not then at all common, and, like many new things, was claimed to have virtues it did not possess. The engineer of the plant had never seen any, and my friend was telling him its wonderful qualities, winding up with, "Take that," handing him a scrap of it, "and put it into your fire, in the hottest place you can find, and let it lie as long as you wish, then take it out and let it cool off, and you will find it just the same as now."

The engineer hunted up a piece of old shovel, and laying the scrap of asbestos on it shoved it carefully into one side of his boiler furnace and left it there for perhaps half an hour and then withdrew it and let it cool off. He then brought it around for our examination and we found it would crumble into powder very easily. The M. E. was dumbfounded. It wouldn't do to say it was the result of impurities, as he was furnishing it, and he had just said it could not be affected by heat.

When we were ready to start the engine it was along after midnight, and the superintendent had partly taken things into his own hands and had his men connecting pipe, putting on belts, etc., declaring he would run it in the morning sure, regardless of our work—even if he had to finish our work.

We were about done, as the valve alone remained to be adjusted. With his gang getting the center was no easy matter, as they would pull when he yelled and not as I motioned, and so woul' go too far and have to come back again. There were altogether too many men around and also too many bosses. Suddenly the engine seemed to stop while the men were turning it over. I gave a yell to stop pulling just as the superintendent gave a yell because they were stopping; the men gave an extra jerk, when, snap, something let go. Examination showed a broken eccentric. The pillow block was bolted to the bed which extended out so far that it was under the eccentric. Some one of the men pulling at the wheel had laid a chisel down on the bed and it had been just large enough to wedge in and crack the hub of the eccentric. Just why it failed to break the strap also I cannot say, but the strap was uninjured.

We found a casting next day in a machine shop in the town, and had it turned up while we got the pulley and flywheel off, and as the superintendent was now thoroughly disgusted with us, he let us get things going without further interference.

By an oversight, which I think I was to blame for, the cylinder had come from the shop without nuts for the valve stem gland studs, and I had to skirmish around town for some. I was directed to go to the railroad shop for them. While there I had the pleasure of learning that I didn't have all the stock of ignorance there was in the machine business. I hunted up the man in charge—I am not sure whether he carried the title of master mechanic, general foreman or superintendent, but he was the head of it at any rate. He was an over-important, pompous, driver of a fellow, not born in this country, I am happy to say, and to him I stated my need of two 5/8-inch hexagon nuts, 11 thread. "Eleven thread, eleven thread," he snorted. "If you get any 5/8-inch nuts they will be eleven thread, as there isn't anything else made in this country."

While I had a vivid recollection of the 10-thread 5/8-inch nuts that used to be on the old oil country steam engines, and the 12-thread ones that were on some makes of pump, I thought best to say nothing or I might not be able to get nuts of any kind, but went with him to the stockroom, where he directed the man to give me two 5/8-inch nuts. "And see that they are eleven thread, please," I said, as the man started away.

"Young fellow, didn't I tell you that all 5/8-inch nuts are eleven thread. You never saw anything else if you only took notice," and he gave me quite a lecture on the necessity of going across the pond to get really good men who understood their business. He was too restless to stay long in one place, and was gone before his man returned bringing a handful of 5/8-inch nuts with three different pitches of thread, all from the stock of the man who had only one.

I don't so much object to a man's being dumb as I do to his thinking his little stock of dumbness is all the knowledge there is in the world.

Mr. Tecumseh Swift knows more, no doubt, about egg-shells than a hen does or ever will, but he knows better than to think he can beat her at producing them because of his superior knowledge of the theories, or I am very much mistaken in my opinion of him.

That engine was running well enough when I saw it on coming back a few days later from a trip down around Bradford, and I was treated almost civilly by the superintendent, who told me he knew of nothing that I could do to improve it.

W. OSBORNE.

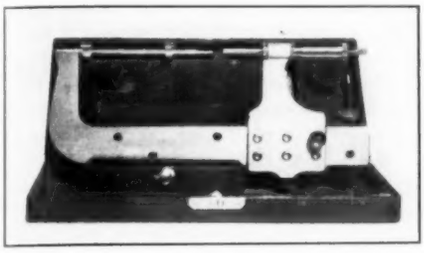
To black small articles of polished brass: Make a strong solution of nitrate of silver in one dish, and of nitrate of copper in another. Mix the two together and plunge the brass into it. Now heat the brass evenly until the required degree of dead blackness is obtained.

Letters From Practical Men.

Improving the Starrett Micrometer Case.

Editor American Machinist:

The enclosed photograph shows a handy addition to the case for a Starrett 6-inch micrometer. It consists of a wood clamp made in two pieces, one of them fixed to the bottom of the case. A screw with a knurled nut draws them together. The test pieces shown in the cover I find convenient to test settings. A thermometer is also attached to the cover, a small portion of which shows in the photograph. Two cork pads, covered with the same material as the lining of the case, serve to keep the micrometer from moving about in the case when closed.



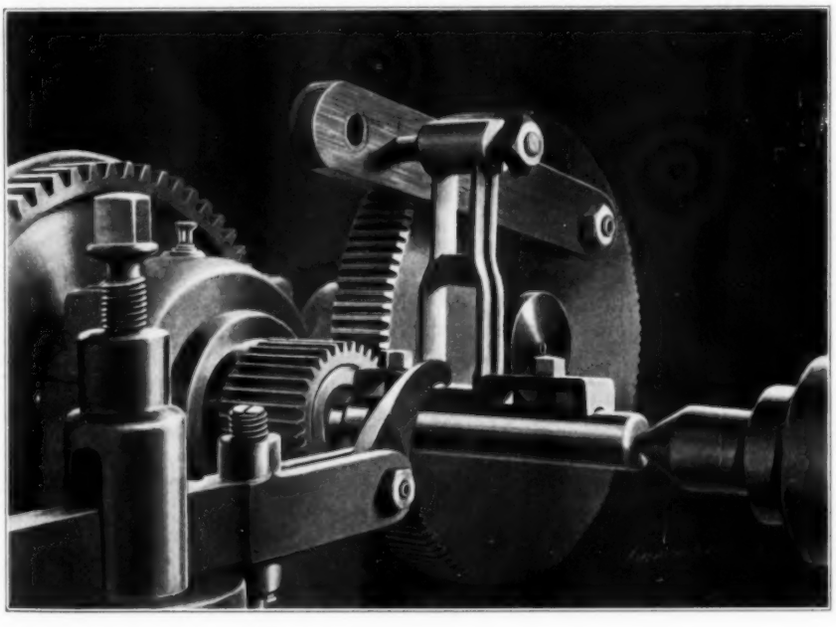
IMPROVED CASE FOR THE STARRETT MICROMETER.

W. A. WARMAN.

Special Oscillating Turning Device.

Editor American Machinist:

Having quite a number of pieces, such as is shown in the cut, to finish, it struck me that there must be some way of doing this operation without turning the work backward and forward by hand. After some thought on the matter this fixture, which is attached to an ordinary 16-inch engine lathe, was worked out by the writer. It did the work for which it was designed in such a satisfactory manner and evoked from all who have seen it in operation such favorable comments, it was thought worth while to give your readers the benefit of the idea. The driving pinion is attached to the spindle of the lathe. The back gear shaft is removed and a stud inserted on which is carried the gear to which is attached the connecting rod, which gives the work the oscillating motion which is required. While the device has been designed to do the job as shown in the cut, it can be readily adapted to do any turning which does not go through a complete revolution. The cutting tool is made adjustable vertically, as shown in the cut.



OSCILLATING TURNING DEVICE.

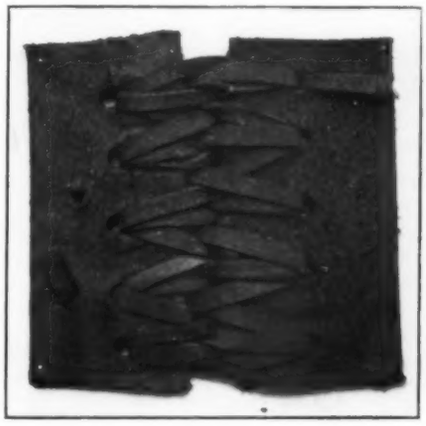
ROBT. J. SMITH.

Harrison, N. J.

A Sample of Belt Lacing.

Editor American Machinist:

I enclose a piece of belt showing a method of lacing that possibly may be new to some of your readers, as it was to the writer. This belt was used to drive three spindles of a twelve-spindle lathe, there being six live spindles in the headstock and two live and four dead spindles in the tailstock. The belt was quite short and ran at a pretty fair rate of speed, passing around the three small spindle pulleys and two idler pulleys also. The slipping of the lacings in their holes, owing to the numerous short turns, caused both them and the belt to wear out very rapidly when the lacing was done in the customary manner, and this method was then adopted, with very satisfactory results, a common belt lacing, split in two lengthways, being used. Recent changes in the lathe have permitted the use of a much longer belt, and it was decided to eliminate lacings altogether and use an endless belt.



A SAMPLE OF BELT LACING.

W. A. SYLVESTER.

[The style of lacing shown is not new, and has been shown in our columns many years ago. The arrangement permits the belt to bend in either direction, as when passing around a pulley, without straining the lacing at the convex side, and thus to some extent it avoids the slipping of the lace in the holes and the consequent wear. —Ed.]

Doing the Impossible.

Editor American Machinist:

I often make dies that I do not think will work, for sometimes it is only by attempting the apparently impossible that we find out what is possible to do. Perhaps a case that happened a few years ago will come in good right here. A manufacturing firm had a large amount of work to be punched out, all of the same pattern, and after a number of trials a compound die was made which punched out a finished blank at every stroke of the press. This was found to be quite inadequate for the number wanted per day, and a blueprint was sent to a well-known firm of well-deserved reputation for the designing and the making of press tools, with the inquiry as to the cost of a compound die to punch a finished blank.

The reply came back that it was impossible to make a die that would do the work in one operation; it must go through a second. The parties then sent a second letter, saying that they already had one die in use and only wanted a duplicate on account of the large number of pieces wanted. This of course placed the diemakers in a cavity; but a reply came back, saying they had misunderstood the matter, and if they would ship them the die they would make another for the sum of —— dollars. As the first die was in constant use day and night, this could not be done, and a second die was made in the shop.

This shows the folly of saying a thing cannot be done, because you don't see a way to do it. Not many weeks ago I had a die sent me for broaching eight

slots in a small engine stuffing-box nut, cutting eight grooves in the nut ⅛ inch wide, ⅛ inch deep and about ⅜ inch long for the spanner to catch into. The die was well made and was a nice piece of work, and I said it was a pity to put that die into a press, for it would do hree or four nuts or perhaps a dozen at the most before breaking, as it would not stand up to the work and they would have to go back to milling. Well, the die has done between two and three thousand and is good for as many more for all I can see, and this makes me cautious about expressing an opinion when I see an impossible (?) tool of any kind shown.

The various articles on dies and press tools have a great interest for me. I have been collecting them for some years and have compiled them all into one book and they make quite a volume.

J. L. LUCAS.

Homes of Workmen in England.

Editor American Machinist:

The article by Mr. Tecumseh Swift at page 853, 1901, describing homes owned by workmen in Vermont, wa most interesting. The impression I gathered was that local conditions in St. Johnsbury were favorable to the acquisition of homes in which the owners could take legitimate pride, the cost of land and building not being so heavy as to preclude a little architectural and landscape effect. I may be wrong, but my casual information leads me to fancy there is too much hotel and boarding-house in the States [this is not a besetting vice of the wage earners] and too little home, and the illustrations in Mr. Swift's article ought to stimulate enquiry into the subject. A little detailed information as to cost of building and upkeep of such homes, the methods by which such costs are defrayed, and the building materials used, ought to be of interest to many readers. Some of the houses shown appear to be built of wood [all of them are wood], which in most cases would be quite out of the question in England, though this material seems to lend itself well to decorative effect. No doubt wood is very cheap in Vermont.

In England the last few years have seen considerable improvement in the general design and healthfulness of dwellings occupied by various grades of workmen and salaried officials. Prominent among the house-building societies of Great Britain are those connected with the co-operative Distributive Societies, whose membership consists principally of artisans and mechanics generally, and a short account of the extent of their operations in the house-building line, extracted from a report presented to the Co-operative Congress held at Cardiff in 1900, together with the methods of repayment of principal and interest, may be in order. For the information of the Congress, returns were asked for from 333 societies, of which 224 sent in replies. The houses built and owned by the societies, as landlords, numbered 4,247; the houses built and sold by the societies, 3,709, and the houses built by members on advances made by the societies, 16,082. The amounts involved were:

Expended by societies on houses owned as landlords	$4,586,985
Expended by societies on houses sold to members	4,139,115
Expended on houses built by members	17,011,530
Total	$25,737,630

The extent to which advantage is taken of the facilities for house-owning through co-operative societies varies greatly in different districts. Speaking generally, the northern manufacturing counties of England are most prominent in the matter, Scotland and the southern English counties being practically negligible in this connection. Bolton (Lancashire) easily leads the way. The report divides Great Britain into seven sections, and I will place on record the town in each section which figures highest on the list.

Touching on the "thrift" question, a summary of the recent annual report of the Bolton Co-operative Society may be worth noting. The membership was 28,000. The trade for the year was $3,861,755; net profit, $594,665. The members had added to their savings during the year the sum of $687,965, and withdrawn (including interest and dividends) $1,182,545. The total savings standing to their credit amounted to $3,010,415. There were 1,576 persons owning their own houses in Bolton who had been assisted by the society to become owners of that property. The reserve fund stood at $56,895. The society employed 862 persons, nearly 300 of whom were producers. From the profits, $14,865 had been placed at the disposal of the Educational Committee during the year for the interest and enlightenment of the members. The sum of $2,520 had been subscribed to charitable and kindred institutions.

JAMES VOSE.

Manchester, England.

NAME OF SOCIETY.	Houses Built and Owned by Society as Landlord.			Houses Built by Society and Sold to Members.					Money Lent by Society to Members to Build Houses for themselves.				Conditions of Borrowing.			
	Number of Houses.	Average Value.	Total Amount.	Number of Houses Sold.	Total Value.	Amount paid on Account of Houses.	Amount remaining due to Society on Mortgage.	Average Cost per House.	Total Amount	Amount Repaid.	Amount remaining due to Society on Mortgage.	Number of Houses on which Money has been Advanced?	What Percentage on the value of a house does the Soc'y lend?	How much in Amount may any one Member Borrow?	Rate of Interest Charged.	Terms of Repayment.
Midland Section—		$	$		$	$	$	$	$	$	$			$		
Derby	65	1,025	66,680	26	38,040	16,265	21,775	1,460	886,820	567,155	319,665	755	90	3,000	4%	$0.12 per week per $100.
Northern Section—																
Newcastle-on-Tyne	29	2,105	61,055	..	.....	.....	.....	....	632,560	227,525	305,035	357	95	2,250	5%	$0 64 per month per $100.
Northwestern Section—																
Bolton	7	985	6,895	47	36,885	36 885	.....	790	3,130,305	1,984,375	1,148,630	*	90	5,000	4%	$0.40 per month per $100.
Scottish Section—																
Paisley	17	....	19,585	..	.....	.....	.....	....	.....	.....	.....	....	..	.....	....	.....
Southern Section—																
Lewes	..	....	.....	9	8,200	8,200	.....	875	795.550	443,470	352,075	780	80	No limit	4%	.....
Southwest Section—																
Plymouth	..	....	.....	..	.....	.....	.....	....	578,845	290,700	288,150	420	..	2,000	4%	$0.14 per week per $100.
Western Section—																
Newport	7	1 400	9,800	..	.....	.....	.....	....	78,150	31,280	46,870	120	80	2,000	5%	$12 per quarter per $500.

* Cannot state number of houses, but have advanced money to 2,430 persons. 1,197 persons have paid off their mortgages, leaving 1,233 accounts still open.

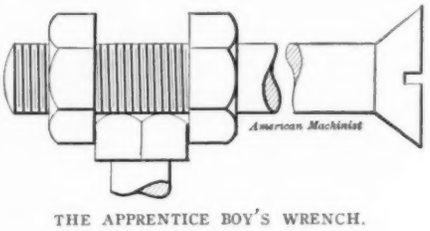
RETURN RELATING TO HOUSE-BUILDING OPERATIONS IN ENGLAND.

The Apprentice Boy's Wrench.

Editor American Machinist:

Not long ago an apprentice boy did a very ingenious trick which I think worthy of mention.

An old vacant building was rebuilt and an electric-light plant was to be installed. The people who had the contract to put in the plant wanted a neat job of wiring done, so they instructed one of their elec-



THE APPRENTICE BOY'S WRENCH.

tricians to take a boy with him, look the place over and remove everything—such as old pieces of boards, etc.—from walls, ceiling or posts where the wires were to be strung.

The electrician and the boy started out, but took no tools with them as they were to be delivered with wire, etc., later on. They were getting on well with the work, when they came to three posts with boards attached to them with ⅜-inch lag screws. "These boards must come down," said the electrician, "but we are stuck for want of a wrench; we'll let it go at that, and I'll go out and take a smoke until the wagon comes."

The apprentice took a stroll about the building to pass away the time, and accidentally found some ⅜x8-inch stove bolts—the boy was *there with the goods*. He took a bolt, turned the nut up to the end of the thread, placed another nut on the bolt, and, using this as a wrench, took out all the lag screws and had the posts clear and ready for wiring when the electrician returned.

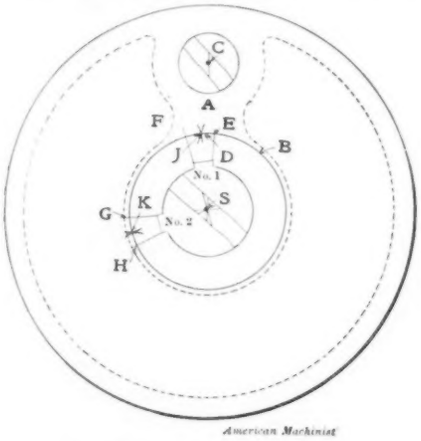
Moral: Sometimes the apprentice has things in his head that don't come out with a comb. B. M.

Duplicating the Laying Out of a Crank Disk.

Editor American Machinist:

The sketch shows a way of laying out the keyways in a crank disk. The old disk, broken out at the crank-pin hole, was sent to the shop to have a new one made to replace it. The shaft was left in place several miles from the shop; it being an unhandy one to get out, it was thought best to leave it in place and to drive the new disk on with a battering ram.

The broken pieces were put in their



LAYING OUT A CRANK DISK.

original places and a light band was shrunk around the disk to keep them in place. The keyways were in very good shape, except at the ends, where they were both broken out badly. They were not put on the quarter and neither was in line with the crank-pin, but about as shown in sketch.

After the new disk was faced off on both sides, turned and bored for the shaft, the crank-pin hole and keyways were laid out as follows: Temporary centers were put into the holes of both disks. The centers were located in the old disk and in the hole for the shaft in the new one with a pair of "morphidites," then with a pair of dividers set to the centers *S* and *C* of the old disk the amount of throw was transferred to the new one. Next the circle *B* was struck on the hubs of both disks, a straight-edge was placed on the hub and a line was drawn from center to center across the circle *B* at point *D*. Then a small straight-edge was held firmly in the corner of the keyway No. 1 and with the larger straight-edge bearing against this one and on the center mark *S* the line *E* was drawn, and moving the small straight-edge to the other corner of keyway the line *F* was drawn. The lines *G* and *H* were drawn in the same way. Next the center *J* was found between *E* and *F*, and *K* between *G* and *H* on line *B*. Then the dividers were set to the points *D* and *J* on circle *B* and the distance was transferred to the new disk. Then the dividers were set to points *J* and *K* and transferred to the new disk in the same way. On the new disk a line was then made from point *J* to the center *S*, and also from point *K* to center *S*, thus locating the centers of the two keyways. The keyways were then laid out from these lines in the usual way and they matched correctly with those in the shaft when the disk was put on.

M. H. BALL.

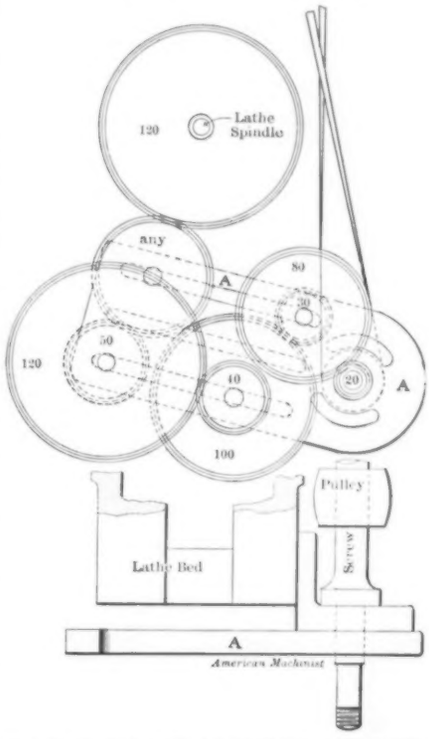
Gearing Up a Lead Screw and Driving by it for Steep Helical Pitches.

Editor American Machinist:

I read with much interest the article by "Lathe Hand" at page 490, describing a method of cutting helical grooves on the planer. It is all right where the circumstances are suitable. The job to be cut must necessarily be a short one. I will try to show how these jobs can be done in the lathe:

With a lathe suitable for such a job it would be possible to do long or short work equally well, without any or with very little extra fixtures. My experience of American lathes and machine tools is that they are superior to the English tools. Of course there are good and bad, but as I have been in touch with the latest machine tools of American make for the last ten years I must give them the first place, especially in adaptability to the various jobs. I find, however, that most of the American lathes have very fine lead screws, such as ⅛, 1/6 and ¼ inch pitch, while the English screw-cutting lathe seldom has less than ½ inch pitch. This difference in pitch, however, is not alone what makes the English lathe more adaptable for cutting helical grooves, such as 17 inch pitch. Certainly it is in its favor, but such pitches as 17 inch cannot be cut in either English or American lathes in the ordinary way. I have had some experience in what we call in this country scroll cutting, and the coarsest I ever cut was 48 inches pitch, left hand, with ten leads, and this was done without any special gears except that it required nine wheels to cut it with a ½-inch lead screw.

Now, this is one point where the English is better adapted for cutting coarse pitches



TRAIN OF GEARS ON AN ENGLISH LATHE FOR CUTTING 48 INCHES PITCH—SCREW ½ INCH PITCH.

than the American, as there are not many American lathes in which you can gear nine wheels between the lead screw and the spindle. The principal thing which makes the English lathe more adaptable for this purpose is the position of the lead screw itself, which does not lie so snug to the side of the lathe bed as the American does.

As will be seen, it is next to impossible to cut such pitches as 17 inches, not mentioning 48 inches, in the ordinary way. My method is to connect everything in the usual way, such as fixing change wheels, etc., and then, instead of driving from the countershaft to the cone pulley on the lathe, I belt from the countershaft direct to the lead screw which drives the lathe spindle and the work. I have always used this method on pitches from 3 to 48 inches, and if I had any coarser pitches to do I should certainly do them the same way if the wheels were obtainable. Then there are the nuts to be considered.

I may say that these jobs were done without any more difficulties than in cutting an ordinary thread in the ordinary way. The lathe was a 10-inch center one, or 20 inches swing, and the "quadrant" was one with three slots in it, as you will

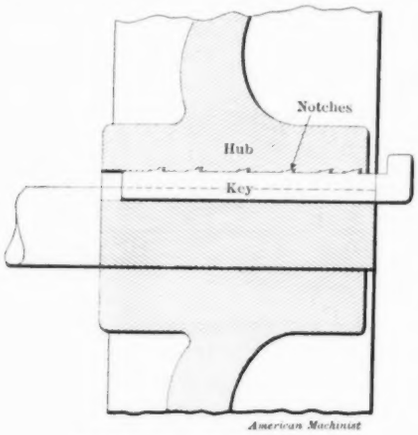
see by the sketch, which I hope will explain this method more fully. Of course, the countershaft had to be slowed down to suit. The method is described somewhat in a short article at page 488 by F. W. Shaw. H. Du Rose.

Birmingham, England.

Fastening a Track Wheel.

Editor American Machinist:

At page 481 R. A. L. illustrates a "device for fastening key in track wheel." I am a mining machinist and have seen some of the fastenings as illustrated. They are very good for the purpose intended, if only R. A. L. would go a step further and tell us how to remove key and wheel from axle. Understand me: I know how to do the job, when put together in a mechanical way; but when the wheel and key are driven on the axle so tight that the Devil could not budge it, then I am looking for instructions. Not long ago I was obliged to remove a broken wheel from a mining car. The wheel had a fit, and so did I



FASTENING A TRACK WHEEL.

after trying to get it off. In putting on a new wheel I turned the axle so that the wheel was an easy fit by screwing on. By screwing on I mean that I took a coarse cut over the axle where the wheel was located, so that I turned the wheel on by hand; then I notched the key as shown in the sketch, notching with a thin, sharp chisel. The car is bumping every day, and the wheel and key are there still.

Mining Machinist.

"To Fit."

Editor American Machinist:

A piece of hard rubber was to be fitted to the top of an oscillating brass arm to carry an insulated electric contact. The brass arm had been finished and the rabetted seat for the rubber block milled by a man who was usually extremely accurate in his work, and I took it for granted that the piece was to drawing figures all over.

This was an error on my part. Nothing should ever be assumed by the top man when he has the thing that exists at hand. No matter how good a workman is, he will make a faulty dimension sometimes. A casting may be a little bit lean, and a dimension may be slightly changed to save the piece; this change may be made by the workman under directions from the top man, who may forget that the change was made before the fitting piece is given out to be finished. The machine shop is no place for guesswork. The guessing should all be done in the drawing room, where guesswork is the rule in all new constructions. The shop is a place of real things, and the actual piece, rough or finished, should not be "supposed" to be anything; it should be inspected and known as it actually is.

I gave Fay the rubber stock for the insulation, with an accurate drawing for the insulating block to be made, the figures for the seating surface corresponding to the figures for the seat on the brass arm, and told Fay that the insulating block was to fit a seat on a brass arm which Harry would give him. Mark the language. Had I said "which you will get from Harry" Fay would have lacked an excuse for what he did. Again, had I gone to Harry and obtained the arm and put it in Fay's hand, he would have had no excuse. The work is small and fine and all the hands on it are toolmakers.

I was busy on the drawing-board and went to my work, leaving Fay with this simple job of fitting a little rubber block to a little brass arm, supposing I had done my whole duty. The next occurrence was the appearance of Fay in the drawing-room with the rubber block finished as to outside dimensions to the drawing, and not fitting the seat on the brass arm, which he had found to be inaccurately finished after he had made the rubber block. The rubber block was to be bored to a certain radius, and had a hub of a given diameter concentric with the boring. The error in fitting made the rubber block too low to bring the rubber hub up to radius and diameter, and the piece was spoiled from a toolmaker's point of view. In point of fact, it was not a waster, as the hub diameter was not a matter of any importance, and a 32d less hub diameter cut no figure. I said to Fay: "You had the brass arm with the seat for the insulation block finished, and should have measured the seat and seen what it really was." Fay was indignant, and said that when his work was to the drawing he was free from blame, and also said that Harry did not give the piece to him, that he had to go to Harry for the piece, and that in fact he, Fay, did not see the brass arm until after he had finished the insulating block to outline. I told Fay that when I gave him the insulation drawing I also told him it was to fit an already finished surface, and told him where to get the finished piece, and that I thought he was wrong; that he should have measured the arm the first thing he did, and that he should have seen that he had stock for the hub of the given radius and diameter on the insulation block before he cut it down to the precise outline dimensions of the drawing. Fay was mad, and said that he did not like to be found fault with when his work was to the drawing. I told Fay that I was perfectly aware that he was correct, that the modern toolmaker was not expected to know anything more than to follow the drawing, and that he was not supposed to either have or use any discretion or foresight whatever, and that I found no fault with him, and that the fault was mine because I did not put the brass arm in his hand, and tell him to measure it up the first thing he did on the job. This galled Fay, but as no reply was possible he kept still while I told him to have the hole in the insulation block to radius after correcting the faulty fitting, and turn the hub as large as it would work. And this closed the incident, leaving Fay with the conviction that he had been unjustly blamed, and me dissatisfied with myself, as I made the drawings and gave the work out and the job was finished to the drawing by a good workman, and was not what I called for.

I use the words "To Fit" inscribed as near as possible on the drawing to the fitting surface, in most cases where two surfaces are to fit each other. This "To Fit" gives the workman notice that his piece is to be of dimensions given on the drawing, and *also* that it is to fit another surface, and fixes the blame on the workman if his job does not meet both conditions. I did not write "To Fit" on the insulation block drawing, so Fay had his excuse—a very thin one, but one which I could not traverse. Of course I thought Fay had notice enough, but I could not say a word. All I could do was to instruct myself to never again omit the legend "To Fit" on any drawing whatever that I make or have made. "To Fit" goes, from this on, and the toolmaker will have to take the blame if the piece doesn't fit, because "To Fit" makes him at least ask "Fit what?", and this question makes it sure that he gets information explicit enough to enlighten even a toolmaker's hide-bound perceptions. John Randol.

The Kit of an English Machinist—Taper Gages.

Editor American Machinist:

I have often noticed in your columns articles descriptive of means devised or adopted by various correspondents in measuring the depths of drilled and other holes and recesses. Some of the gages illustrated being very ingenious, elaborate and—too costly for other than special work in quantity, induces me to observe that machinists, fitters and erectors carry very few personal tools into the shops in England. Their stock in trade usually comprises a pair of 6 or 7-inch inside calipers, a pair of outsides about the same size, all of personal make, as is also the square, solid forged with 7-inch blade, the

back grooved for lightness, and admitting of being used as a box-square or keyseat rule—these all carried in the vest pockets. A 2-foot slide rule, 12-inch steel scale straight-edge and a scratch awl are carried in the rule pocket in the overalls, the scaled slide serving as a lengthening leg or depth gage to its full extent of 12 inches. All other tools are furnished as shop equipment.

Referring to article at page 629 about taper work, by Mr. Morris Fulton, I would say that several years ago I made a straight-edge, 2 feet long, 7/8 inch wide at one end, 5/8 inch wide at the other, standard keyway taper of 1/8 inch per foot, by the use of which one caliper setting will apply equally at each end of a keyway in the eye of a wheel, if properly finished. It would also equally apply to Mr. Fulton's illustration if the *radial* taper be the same, when a parallel straight-edge applied to the parallel part of the piston rod shown, and projecting over the taper part would lie parallel to the upper edge of a taper straight-edge applied to the tapered part of the article. Of course when one has many articles to form it should not be a great matter to make straight-edge gages of suitable length, form and taper to suit requirements of such work as it arises, and preserve them for future use. A micrometer screw attached to a straight-edge may be used to indicate the difference in radii between large and small ends of taper; or a trigonometrical scale might be made giving the length of slant hight—hypothenuse—in relation to its axial length.

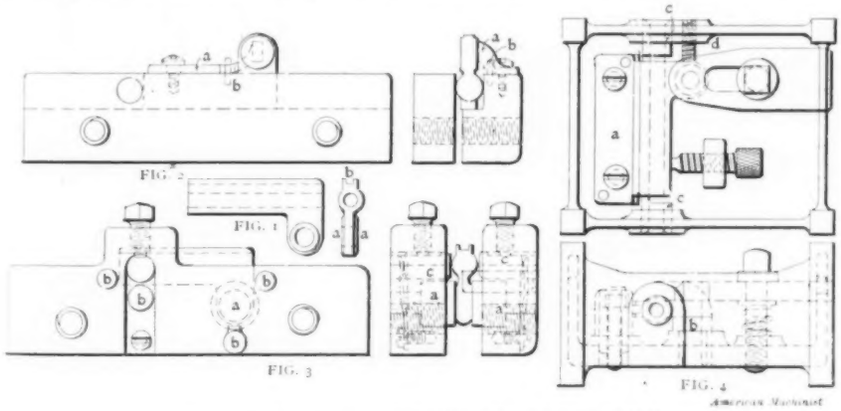
I. W. P.

A Milling and Drilling Job.

Editor American Machinist:

The drawing shows a finished machine part with three tools for machining it, including two milling fixtures in the form of vise-jaws fitted to a No. 2 Brown & Sharpe milling-machine vise, and a drill jig. The first cut taken on the piece, Fig. 1, is with straddle mills at *a a*, for which the fixture, Fig. 2, was used. The work rests on the shelf of the vise-jaw, as shown, and is fastened so that it will be in contact with gage *a*. This gage swings against the pin *b*, and after the work is secured in place it swings back out of the way, to allow the cut to be taken on both sides at once.

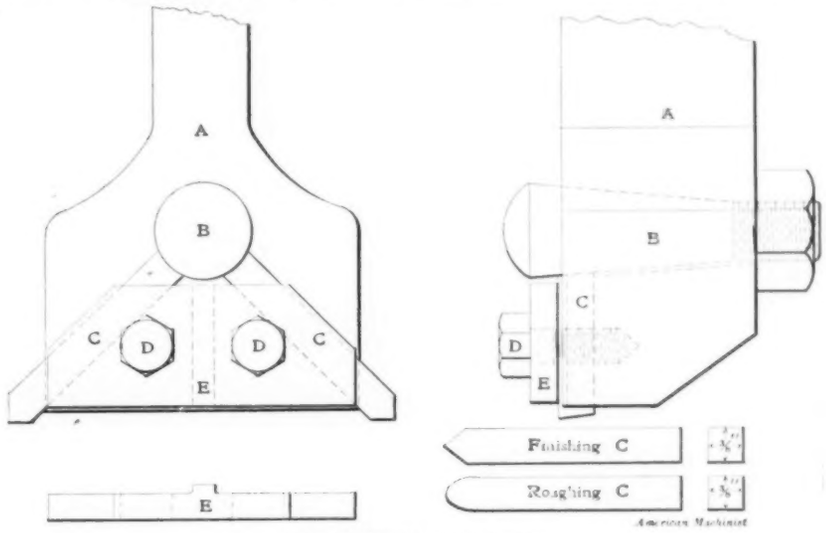
The next operation is milling the slot at *b*, for which the fixture, Fig. 3, was designed. It was required to have this slot true with the cut already taken and also with the hole to be drilled. While the first pair of vise-jaws were of machine steel, case-hardened, this pair is cast iron, planer finished, with two hard-steel blocks inserted at *a* to grip the work. The faces of these blocks are ground parallel with the back sides of the pieces in which they are set. The work to be operated on is located vertically and horizontally by the pins *b b b b*. The free end of the work is held in position sideways by the spring operated pins *c c* being allowed to come in contact with it and being then securely locked by the screws above. A groove is cut on the back side of each half of the fixture for the springs.



TWO MILLING JIGS, A DRILLING JIG AND THE WORK.

These two operations being finished, we are ready to drill the holes. In the jig, Fig. 4, *a* is a hardened and ground steel block with a tongue to just fit the slot we have just drilled in the work. This tongue with the bushing *b*, which has the surface that comes in contact with the work ground to the right hight, locates the work in the jig. It is held in place against the block and bushing by the thumb-screw and clamp shown. Bushings *c c* must be in line with each other and the block *a* located to just the right distance from and parallel with them. This operation is much facilitated by using a six-spindle drill with two each of spotting and reamer drills and two reamers. The long hole is drilled and reamed from each side of the jig, leaving a trifle for a hand reamer. One of the line bushings is left with a lug, to take the thrust of the drill on that side and screw *d* takes it on the other side.

N. A. C.



AN EXPANDING PLANER TOOL.

An Expanding Planer Tool.

Editor American Machinist:

I send you a sketch of an expansion planer tool, which may interest some of the readers. I made a tool like this five or six years ago for planing locomotive shoes and wedges. I found it one of the best and most rigid tools I ever saw. All my work came out standard size. This same kind of tool was used on driving boxes and can be made useful on other classes of work. *A* is the tool-holder; *B*, taper pin; *C*, cutters; *D*, *E*, bolts and clamp.

This tool cost very little; the cutters can be replaced in a few minutes by cutting off two pieces of square, self-hardening steel. I used two pairs of the tools—one for roughing and the other for finishing.

C. W. T.

Grinding Hacksaws.

Editor American Machinist:

Some things have been said in your columns about grinding hacksaws. I have attempted this only when the supply of new ones had given out and have found them better than none.

I have also found that a few strokes of a piece of broken emery wheel across the fact of a hacksaw or coarse file from the handle toward the end, as soon as it

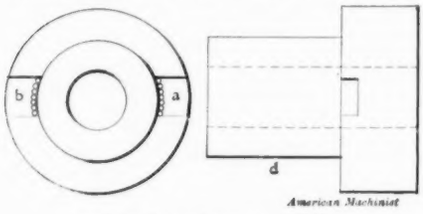
begins to glaze the work, will take the "shine" off and give the tool a new bite.

H. G. KELLOGG.

Locating Opposite Grooves.

Editor American Machinist:

The way the rather unusual keyway in the sketch was cut central with the hole may be of interest. The piece of work was made ready for planing by drilling rows of holes close to the barrel and chipping out between them for the tool to run into. It was then mounted on an arbor, one end of which was fitted to the taper hole of the milling machine index head, the head fastened to a planer platen and the work set in a vertical position. Then with a splining tool considerably narrower than the slot to be finished a groove was cut the required depth, or a little less, at *a*. The work was then turned half around and cut the same at *b*. The work was then swung down to a horizontal position and rotated until the grooves were parallel with the platen. We could now, by cali-



LOCATING OPPOSITE GROOVES.

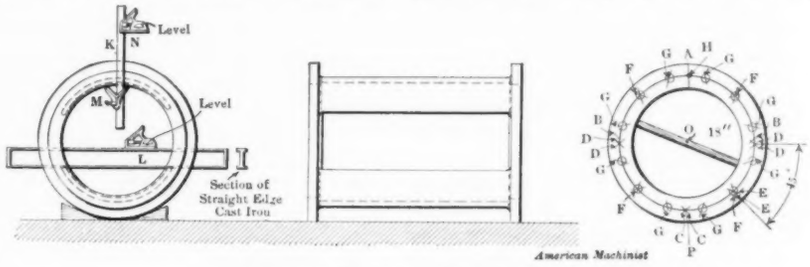
pering with the hight gage from the planer table to the under side of the circular part of the work and the edge of the slot, ascertain just how much more to take off to bring that edge of the slot the right distance from the center of the hole. Resetting the work vertical and putting the index pin in the same hole it was in when taking the previous cut, the required number of thousandths were taken from the side already planed, and then the other side of the groove was finished to the required width.

N. A. C.

Laying Out a Yoke or Cradle for Drilling.

Editor American Machinist:

The sketch shows a way of laying out the ends of a steam engine yoke or cradle for drilling. It has previously been bored, the ends have been faced and the edges of the flanges have been turned to the same diameter. A stick is fitted into each end and the centers are found, and the ends of the cradle are painted with whiting. It is then placed on a level plate or table and leveled crossways by the straight-edge *L* and level, as shown, and secured in this position by the wooden wedges. The edge of the combination-square beam *K* is brought radial by the center head *M* and is then placed vertical by the indication of the level *N* on the upper end, and then line *A* is drawn. A corresponding line *A* is drawn on the other end of the piece. The centers *O* and lines *A* are all that are required for locating the marks to be made, and if more convenient the cradle may be set up on its end, care being exercised to protect the line *A* from erasion. With the compasses or trams, with the radius required—in this case 18 inches—the circle for the bolt holes is struck and



LAYING OUT A PIECE FOR DRILLING.

a prick-punch mark H is made at the intersection of line *A*. Arcs *B B*, struck from *H*, and then arcs *C C* will locate point *P* opposite *H*. From *P* and *H* strike arcs *D D* and then the circle is divided into four parts. Equidistant from these the four points *F F* are located by the dividers and from each of these, with the dividers set to the radius of the circle, arcs *G G* are struck all around, and this gives a layout for twelve holes.

C. W. PUTNAM.

Laying Out a Three Throw Crank.

Editor American Machinist:

The sketch shows a job of laying out or centering a solid crank shaft with three crank-pins, these to be centered so that the pins will clean and finish to the right size and parallel with the axis of the shaft. After the shaft is roughed out to within 1-16 inch of the size on the main bearings it is placed on V's, Fig. 1, on a level and true table. Attention is first given to the inner crank. The shaft is turned in the V's until the center of pin *B* is approximately of the same hight as the center of the shaft, and the jack screw is then adjusted so that the pin just touches it. As there are of course already centers in the ends of the shaft, the point of the surface gage is set to the hight of the main centers and it is then brought around and line *a* is scratched on the pin. The shaft is turned over until the other side of pin *B* rests on the jack screw, the hight of which has not been changed, and line *b* is scratched with the surface gage. A prick-punch mark is made on the pin in the middle between these lines, and the jack screw is then adjusted until this prick-punch mark is the same hight as the shaft center, or the same hight as the surface gage point. Line *C*, Fig. 2, is then drawn by the surface-gage point on the face of the disk on each end, and with the dividers set to the required radius of the crank the circle *e* is struck. The center *F* can then be prick-punched on each end as the center required for turning pin *B*. Circles may be described for the countersink as a check against the running out of the drill

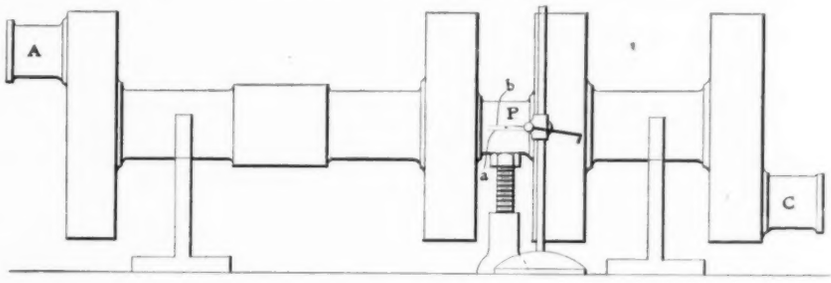


FIG. 1

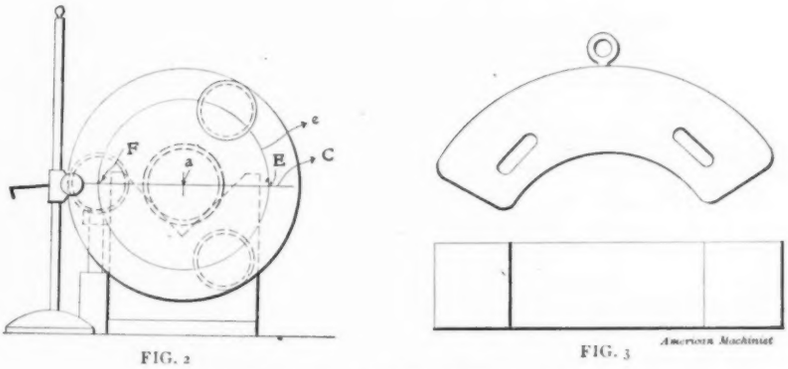


FIG. 2 FIG. 3

LAYING OUT A THREE THROW CRANK.

in drilling the centers. From points *E*, opposite *F*, with radius *d e*, arc *i* may be struck on one disk and arc *o* on the other disk, thus locating on each disk the center for the crank-pin on the other end. If now the shaft is turned and these centers are successively brought to the hight of the shaft center, as shown by the surface gage, the ends of the opposite crank pins may be marked with a horizontal line by the same surface gage. This centers the pins in one direction and by turning the pins successively to the vertical position, either up or down and setting the surface gage to circle *e*, the pins may be marked again and the intersections of the two lines will be the centers required.

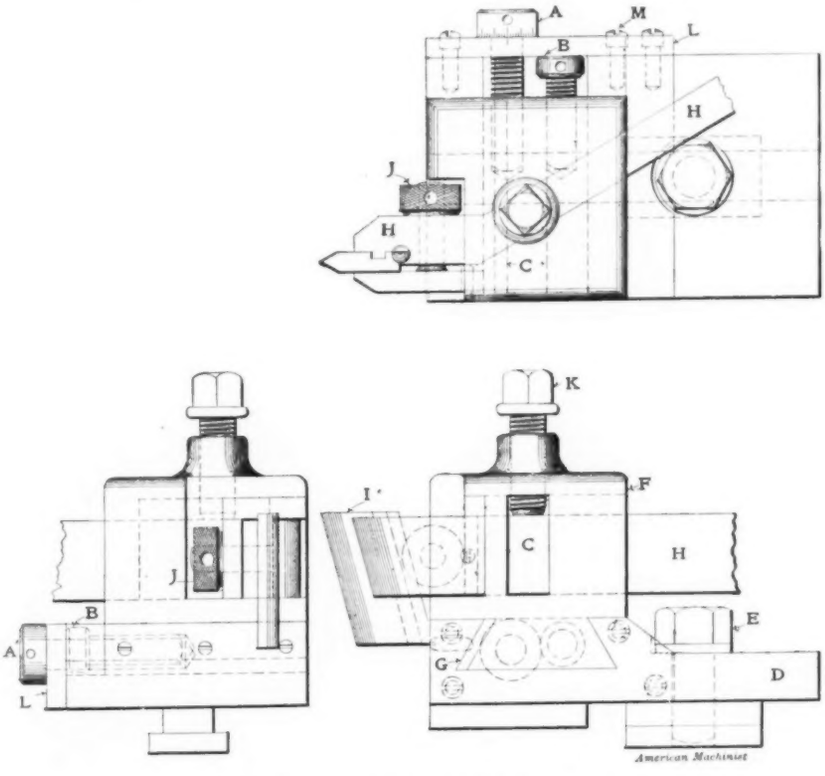
Fig. 3 shows a counterbalance weight to be bolted to the face-plate. The slots allow it to be located correctly and the eye-bolt is used for hoisting.

C. W. PUTNAM.

A Thread Cutting Fixture for the Lathe.

Editor American Machinist:

The accompanying drawing will illustrate an attachment or thread tool-holder fitted to a Pratt & Whitney 10-inch engine lathe. It is a very useful tool in many ways and has many advantages over a tool used in the ordinary way.



THREAD CUTTING FIXTURE FOR THE LATHE.

The base *D* is fastened to the carriage of the lathe by the T-piece and the bolt *E*, and takes the place of the regular block which holds the tool-post. F is a cross-slide or holder properly fitted to a good, solid bearing in the base *D* and fitted with the gib *G*. The slide *F* is worked out at an angle of 30 degrees to receive the tool-holder *H*, as most of these tools are of that angle. It should fill the slot sideways, so there will be no chance of changing the angle of the tool from that degree, no matter how many times you should have occasion to remove it. It is a good plan to take a light cut or grind the sides and edges of the holder if you are at all particular with the results. In removing the cutter or tool *I* for grinding, etc., if you find that it changes the angle any when you ret rn it to the holder and clamp it against its seat by the nut *J*, you can put a piece of tissue paper behind, or enough to bring it just where you want it. Even this would be better if the faces were ground so there would be no chance of its changing. The slide *F* is also provided with a cross-slot *C* for inside tools, both of which are held by the screw *K*. The plate *L* is fastened to the base by the screws *M*. The slide is set by the micrometer screw *A*, and the screw *B* is tightened against the plate *L* just tight enough to be sure there is no lost motion in the slide, at the same time tightening the micrometer screw.

It is often quite an advantage to be able to move the tool very slightly in line with the motion of the carriage without changing the angle and this arrangement enables that to be done.

Should you wish to cut a thread 6 pitch 12 threads to the inch—that means ,of course, a double thread—instead of turning your gears as is the usual way, just turn the micrometer screw 1-12 inch or .0833, and you are halfway between, and so on with any number of divisions that you may wish to make. You may not get it just exactly, as I mentioned before, but by moving the screw you can get just what you want.

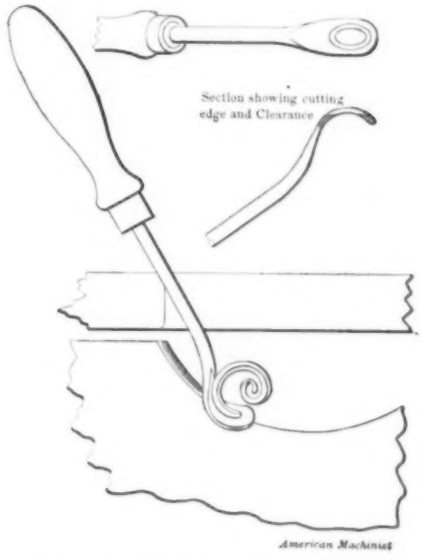
M. W. LEECH.

New York.

A Corner Rounding Tool for Patternmakers.

Editor American Machinist:

The sketch shows and practically tells all about a corner-rounding tool for patternmakers. The cut can be taken from the heel, as shown, or from the toe—that is, by either pushing or pulling—and by tipping up or down the amount of cut is regulated.



CORNER ROUNDING TOOL FOR PATTERNMAKERS.

C. W. PUTNAM.

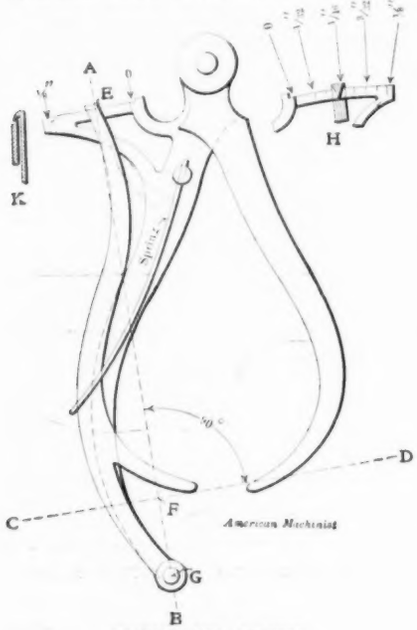
Elevating the Thread Tool for Cut.

Editor American Machinist:

Mr. Osborne's catching-thread tale has drawn out such an amount of comment that I cannot hope to be able to add anything of value, but while thread-cutting is being discussed please allow me to get a word in edgewise. Some of our most "modern" brethren will notice the error of my ways at once and probably condemn them, but mayhap some lathehand who likes to produce all he can, whether doing piece work or not, will want to try it, if he has not already done so.

When cutting external V-threads in the lathe it is undoubtedly theoretically correct to have the point of the tool on a level with the center and the tool inclined in the direction of the thread an amount corresponding to the pitch. Now, I have no fault to find with the inclination of the tool, as that is necessary to obtain the same amount of clearance on each side, but when it comes to keeping the tool on a level with the center I am "not in it," not for ordinary work at least. There are few things that hurt my mechanical feelings more than to see a thread tool laboring under a heavy cut "on the level" in mild steel. I dare hardly term it cutting, and even plowing is almost too good a

name for it; perhaps there's a big word somewhere in the dictionary that just defines that action, but I don't know it, and you just cautioned us against big words, anyway. I had much threading to do in one shop; the pieces mostly made had a thread 25-32 inch diameter, 10 pitch and 1⅜ inches long, and were run in lots of 50 and 100. The tool, when set level with the center, would last through ten or twelve, and the last thread cut before regrinding would be perceptibly rounded at



REGISTERING CALIPER.

the bottom. I commenced grinding more clearance and setting the tool higher until about ⅛ inch above the center, and then my troubles were over. The chips "flowed" off like ribbons, and I have never since failed to thread a whole batch of these pieces without regrinding the tool. The largest number threaded at one time was 103, and no difference was perceptible between the first and the last one threaded. The lot was then finished, but I believe the tool was good for fifty more.

As a matter of fact the tool had to be ground more acute than 60 degrees to obtain the right angle in the thread, and theoretically there should also have been some curvature to the cutting edges of the tool, but in practice no error was noticeable in the thread cut. The gain in time by this method of threading is very pronounced, and greater uniformity is possible, because the tool does not require grinding and resetting so often. If much threading of one diameter were to be done it might be well to make a gage to obtain the correct angle and curvature on the tool for a given elevation above the center, though I have found that the angle may be very closely estimated and when the pitch is not coarse the curvature does not need to be considered, and the thread cut will be fully as true to angle as most threads ordinarily cut in the lathe.

CORNEIL RIDDERHOF.

A Registering Caliper.

Editor American Machinist:

The sketch herewith shows a caliper with a graduated wing and a swinging leg carrying a pointer at the end. On the dotted line *A B* the distance *E F* is six times *F G*. Therefore a movement of ⅛ inch at *F* throws the pointer at *E* ¾ inch. The swinging leg is a free fit on pin at *G* and is held by a light spring at zero. At *H* is shown the graduation on the wing, *K* giving a side view of wing and pointer. If turning a piece to finish, say, 1 inch in diameter, it is roughed about to size, and then by slipping the caliper over you can tell just how much more is to come off.

R.

Making Small Laps.

Editor American Machinist:

At page 476, A. H. shows a lap made of tubing which I think is very good, but this tubing is not always to be had in all sizes and some shops may not have it at all. A good lap for drill jig bushings can also be made of common cold-rolled steel or drill rod, which comes in all sizes and is more likely to be in a shop where drill jigs are made. A piece of cold rolled stock, sawed longitudinally through the center with a hacksaw makes this lap; it can be adjusted by spreading the ends apart.

H. A.

Adjustable Gage for Lathe Centers.

Editor American Machinist:

I send you a sketch of a taper gage I made twenty years ago. The value of the gage has been proven to me many times, when I have had an old stub of a lathe center sent me from some lathe in a shop a mile away; and in the years that I have worked at toolmaking, whenever I have had a lathe center to turn and have used the gage, I have been able always to guarantee a perfect fit the first time.

By placing the center between the blades, holding the blades firmly on both sides of the center, closing the gage so that the blades will rest the entire length of the center, then screwing the thumb nuts firmly down, the gage is adjusted and can be removed. After the first chip is taken from the piece of steel which is to make the new center, when it is tried in the gage it will tell you whether the tailstock is set right for the taper required.

Taunton, Mass. E. A. BANNING.

Allowances for Press Fits.

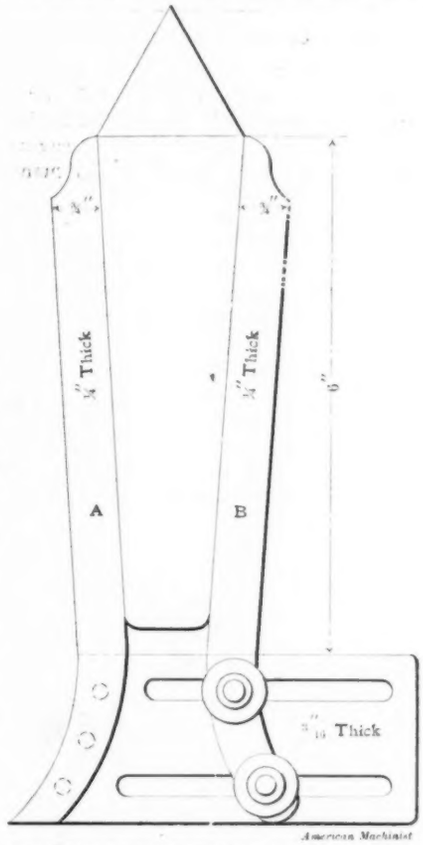
Editor American Machinist:

In recent issues of your paper, two articles have especially attracted my attention —those of Mr. Cook and Mr. Kunz, at pages 194 and 353. With due respect for the opinions of these gentlemen, I have ideas of my own which come from actual experience and practice.

However unfortunate an example the use of the hardened rolls of small bore makes, it should not be inferred that Mr. Cook did not know what he was talking about. It is very evident that the allowance of 0.00075 inch would be far insufficient had the rolls been soft. But for larger work—that is, from 4 to 10 inches in diameter—I believe in an allowance of from .001 inch to .002 inch without any increase for the large size holes.

Mr. Kunz is right when he says that wheels and the like are forced on their shafts firmly for the purpose of doing heavy work, and not merely to hold them in place. Still, a fit is not made when one is forced on a shaft so much too large that a chip is broached out, thus indicating a high pressure while in the press and then leaving the fit next to nothing. Neither should the metal be strained to nearly the breaking point, where something will have to burst when an additional stress is put on.

Experience is a great teacher. What has been done should count for more than



ADJUSTABLE TAPER GAGE FOR LATHE CENTERS.

that which is theoretical. I have worked fourteen years in an engine shop, the last eight of which I had the job of turning up the shafts. These shafts were common steel forgings. The holes fitted were usually bored smooth and not reamed. The iron, as a rule, was of medium hardness. I should like to give here a few examples of work done.

(1) We had two 50 horse-power engines running on one shaft—one on each end—and a cast-iron gear 36 inches diameter and 8 inches face was forced on to the middle. The hub of the gear was 10 inches long and 8 inches bore. As these engines

were to do very heavy hoisting by the gear, a "good rugged fit" was wanted. The shaft was turned and filed smooth .00125 inch large. Then it forced in at 100 tons. The crank disk bearings on the shaft were 6 inches long, 5½ inches diameter. With .001 inch allowance the disks went on at 50 tons.

(2) We had ten smaller engines in a lot. The crank disk bearings were 4 inches diameter, 4 inches long. A pressure of 25 tons was wanted, and I allowed .001 inch. Three of them went on at 23, three at 26, four at 25 tons. The holes were bored, as in the former case, and not reamed.

(3) Here is an example of smaller work. I shrunk a steel bushing on a steel shaft, and it afterwards became necessary to remove it. The bushing had a bearing 2 inches diameter, 4 inches long. The shaft I turned .002 inch large. It took 40 tons to start off that bushing.

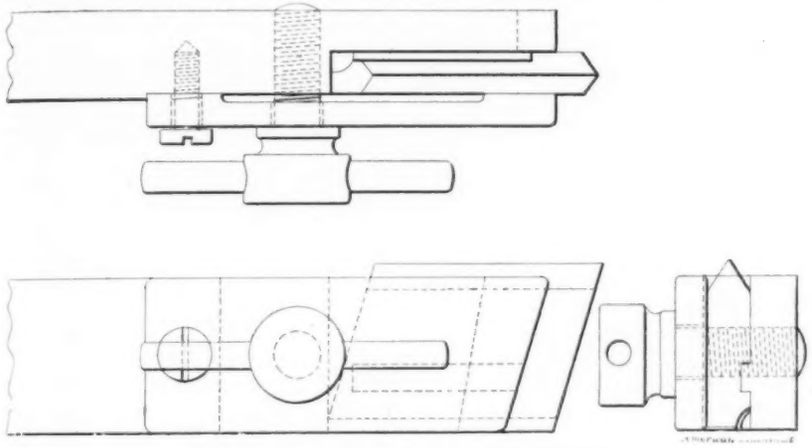
I could cite cases like the above by the dozen, and would close by expressing my appreciation for Mr. Osborne's opinion as given at page 438, that more poor fits are made by being too tight than by leaving them too loose. ELMER F. TANNER.

Providence, R I.

Holder for Grinding Thread Tool Cutters.

Editor American Machinist:

The sketch will show a very convenient holder in which to securely hold, for grinding, the cutters used in the Pratt & Whitney new thread tool. Few shops are provided with the attachment recommended by the Pratt & Whitney Company. We still use the old grindstone, and the cutters being so small they are difficult to hold in the fingers. First we used a spare new thread tool stock, but it was soon damaged by being ground away by carelessness; then this holder was invented and made, and has done good service for a number of years, being constantly in use. The holder is drawn full size with a cutter in position in it. H. E. B.

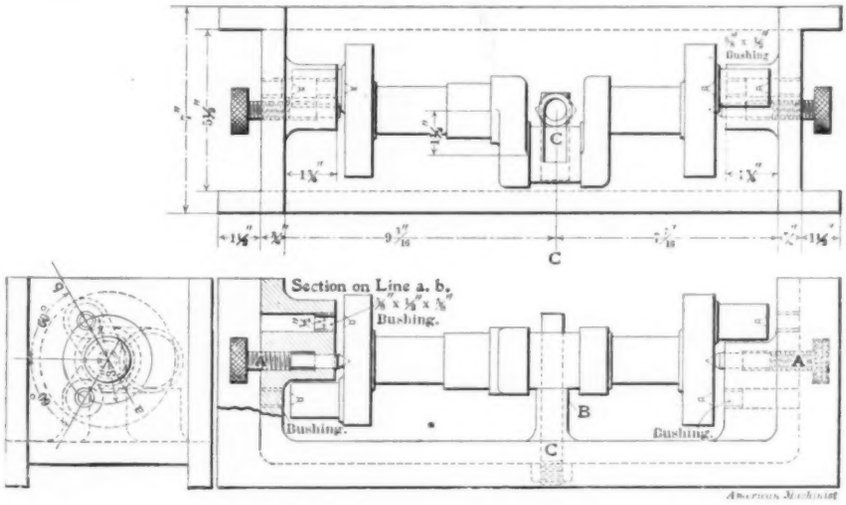


HOLDER FOR GRINDING P. & W. THREAD TOOLS.

Jig for Triple Crank Centers.

Editor American Machinist:

The drawing shows a jig for centering cast steel crank shafts such as are used in 3-inch stroke triplex power pumps. The body of the shaft before it comes to this jig has been turned in the usual way, and the central crank has been turned by the machine invented by Charles Vogel and shown on page 1372, Vol. 24, in which the crank is held stationary and the tool revolves around it. The crank is centered in the jig by the two screw centers *A*, the already turned crank pin resting upon the block *B*, where it is clamped down by the overhanging arm of the bolt or stud *C*. With the crank in this position the other centers are drilled through the bushings provided, bringing them accurately parallel and spacing them 120 degrees apart. As the cranks are outside and easily accessible, they are then turned in an engine lathe in the usual way. C. W. PUTNAM.

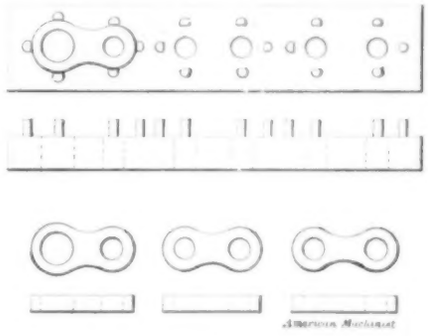


JIG FOR CENTERING TRIPLE CRANKS.

A Small, Cheap Jig.

Editor American Machinist:

I send you a sketch of a drill jig that we used to drill 100 brass castings of each size as shown. As this was not likely to be used again, something inexpensive was necessary. The jig is shown above and the pieces below. The holes were cored 1-16 inch smaller than the drilled sizes and well cleaned of sand. They were not finished in any other part, but the holes were not allowed to vary above .005 inch between the centers. It was not so essential for the holes to be a certain distance apart as that they should be alike. By using a rose bit there was less danger of cutting out the hole in the jig, which was not hardened or bushed, than if a twist drill was used, and there being a hole already through the casting the chips dropped away readily.



A SMALL, CHEAP JIG.

The jig was made of a piece of 1x2½-inch soft steel. The castings were laid on it and marked around, and the holes were drilled for the pins slightly inside the casting outline and then filed off flat until the casting would drop in. The drilling for the pins in this way did not require to be so carefully done, and there was also more bearing surface for the castings to rest against.

After getting the castings to drop into place, one hole was drilled through both a casting and the jig plate, and before drilling the other hole in the same way a pin was dropped into the hole already drilled, thus not depending on the surrounding pins to hold the casting in place. After drilling the first casting of each size and the plate to correspond, the others were drilled with the jig above the casting, the latter resting on the drill press table, the

projecting pins being as long as the casting was thick. No machine work was required beyond the drilling, the plate not being even planed. The making of the jig was much simpler than this description of it. J. L. GARD.

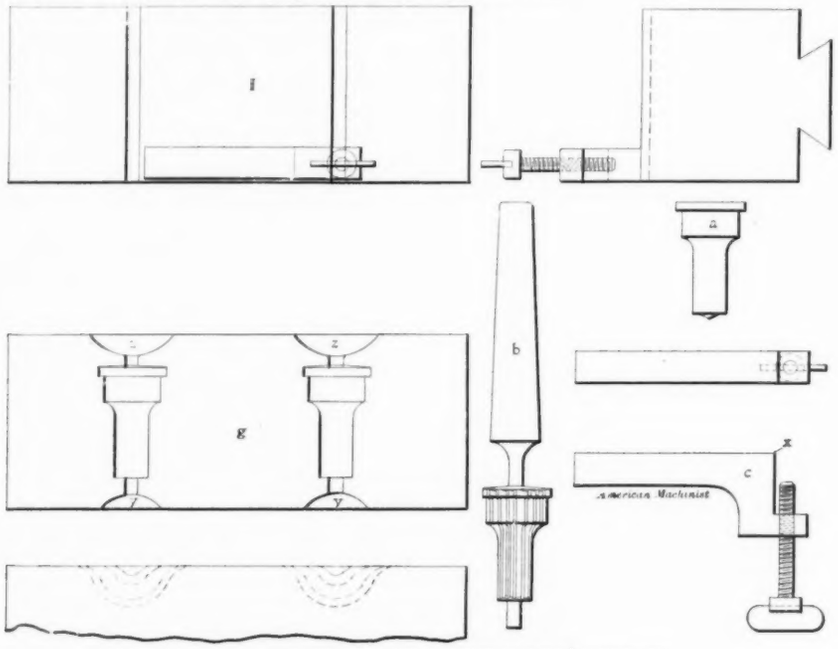
Micrometrical Forging.

Editor American Machinist:

It may perhaps surprise some readers of the AMERICAN MACHINIST to learn that work is inspected in the blacksmith shop with a micrometer, the limit allowed for variation being only .002 inch, which is ordinarily considered fairly close for machine work. This is a matter of common practice in some places, however, and is not considered anything out of the ordinary.

In the accompanying sketch *a* is a fair sample of a piece of work of this class. It is a punch used by boilermakers for rivet holes in the sheets. The only finish required on these punches when they come from the hammer is on the ends, the body being simply polished. They are forged in the ordinary cushion hammer, and to make a pair of dies for the job it is necessary to make a cutter or "cherry," sketch *b*, and a back rest and follower screw *c*. The shank of the cutter is very light, and under ordinary circumstances it would be impossible to sink it in the die, but with the use of a back rest it is supported so that it cannot crawl sideways, and the follower screw holds it up to its work and prevents springing the shank. In this way the shank has nothing to do but to turn the cutter; it is not subjected to any side or bending strain and allows the use of a very delicate shank if care is used in feeding the cut. In tempering, care is taken to get a good temper the whole length of the shank, for if left soft it is very apt to twist off. As tempering is very apt to spring it, before it is used it is placed in the machine after drawing the temper and pened with a punch until it runs true.

f shows one half of a pair of dies, which, of course, in this class of work are always duplicates, and which as a general thing have two impressions. The first operation is to run a light cut with a routing tool across the face at the point where the impression is to be made, using care to cut the same depth in each die. They are then clamped securely together face to face and drilled and reamed, making the half hole as shown, the light cuts previously made serving to guide the drill straight and insuring an equal depth in each half. One half of the die is now clamped securely to the slide of a die-sinking machine and the back rest *c* is placed as shown, the corner *x* being placed flush with the side of the half hole. An ordinary C-clamp is generally used to fasten the back rest.



MAKING DIES FOR FORGING BOILERMAKERS' PUNCHES.

The "cherry" is now placed in proper position in the machine, and it simply requires careful manipulation of the handwheel of the machine and the follower screw to sink it to half its diameter in the die. The shank of the cutter serves as a stop and the half hole prevents cutting too deep.

As this is a roughing operation, the cutter is not forced entirely down at this time. This operation must of course be performed four times to make a pair of dies with two impressions. All of the impressions being roughed out, the dies are placed loosely on the platen of the machine and brought together on the "cherry," and an ordinary patternmaker's clamp is used to force them together. At this time, if the cutter is very delicate, it is a good plan to turn the machine by hand, as it is apt to catch on the corners, and it is an easy matter to lose the cutter at this stage of the game. It is necessary to open the dies several times in this operation to free the cutter from chips, as there is no place for them to work out. Thick, soft cardboard is often used between the dies to prevent closing up too fast under the pressure of the clamp.

We now have a die as shown in *g*, the cuts *y* and *z* being made for stock clearance. The cut *z* should be carried as close to the impression as the strength of the die will allow, as the stock which is drawn down at this point must run out into sprue, and thickness here means waste of material. The corners of the sides of the impressions are now well rounded off with chisel and file as shown by dotted lines in *g*, the ends of the impression being left square.

This done, the dies are ready to temper, and if badly warped in tempering they are frequently ground on a surface grinder, though it is not necessary to true up the entire surface. The dies are now clamped together and a lead cast is taken of the impression. If it measures too large, of course a little more may be ground off the face, but if too small, a lead lap must be made and the impression ground out. We are now ready to place the dies in the hammer and begin forging.

The hammer man knows by experience how far to place his red-hot bar of tool steel in the die to give stock enough to fill it. Of course if he takes too much, the surplus will force out through the hole at the end. To get a forging that exactly corresponds to the dies, it is necessary to hold the bar in place until the dies come together fair, it of course being turned all the time by the operator. It is impossible to get one of these forgings too small, but if the work is done by the piece, it is sometimes taken from the hammer before it is down to size, and I have frequently seen a hammer man called to account because his work was over the .002 limit which he was allowed. This gives an illustration of a case where an inspector uses a micrometer in the blacksmith shop to good advantage. THEODORE.

Pattern Shop Suggestions.

Editor American Machinist:

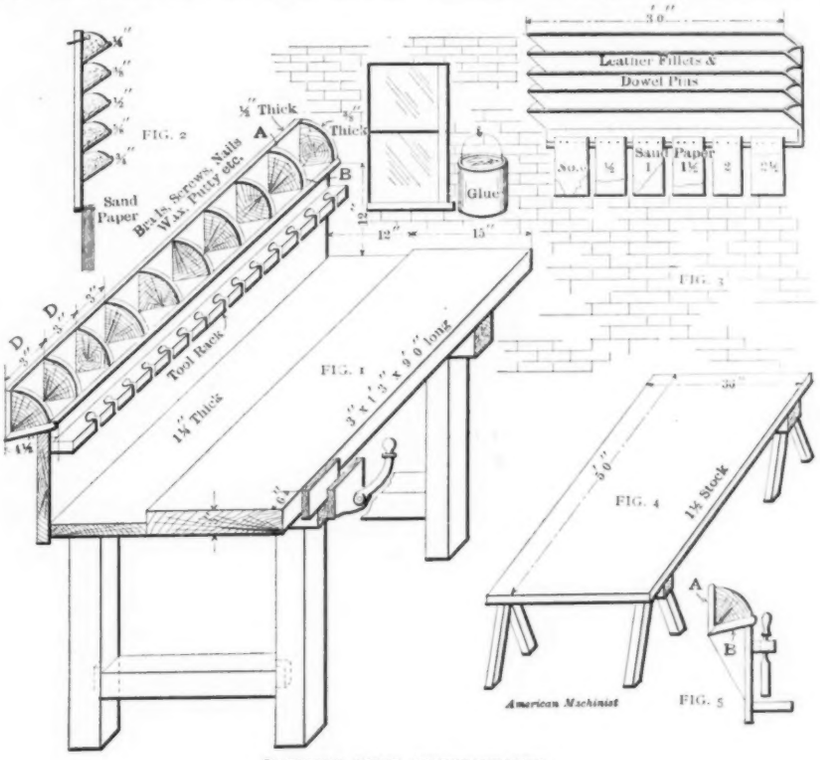
In the pattern shop—like a large number of other wood-working shops—little attention is given to the wants of the worker. Any old thing that looks like a saw or a lathe will do; and as for the lumber, you are never safe without an umbrella when turning; yet after working with this kind of lumber in a pattern the boss will expect every measure to be a hair splitter. But what's the use trying to lay any blame on the boss? He makes every effort to get good, dry lumber and best supplies. It's the lobster in the office who makes the purchase. If he was obliged to work with this stuff ten hours a day he would be more particular.

Handy tools, necessary supplies, such as

screws, brads, nails, glue, sandpaper, wax, dowels, fillets, etc., are much appreciated by a *good* patternmaker and assist him very much in his work. I am pleased to see that a number of the large up-to-date establishments look to the wants of the patternmaker and do not consider that it is altogether "dead horse."

Other pattern shops have supplies, but no place to keep them, and still other shops have nothing to work with. The proprietor seems to think, when he pays 35 or 37 cents per hour, that the patternmaker will furnish everything.

In the sketch that I send of a pattern-shop corner 1 is a bench which I have found very convenient. The pockets at the back of the bench are shown more clearly at 5. The pieces *A B* are made the full



PATTERN SHOP CONVENIENCES.

length of the bench, the pockets *D* are convenient for brads, screws, nails, wax, chalk, etc. It's a part of the bench, always ready for use, and is easily cleaned or the contents changed from one pocket to another. 2, 3 are pockets for dowels and fillets. In this way very few dowels and fillets are wasted. I put only short pieces of fillets in the pockets, ¼-inch fillets with ¼-inch dowels, etc. Under the dowel pockets I tack up sandpaper, as shown, ten or twelve sheets of each kind; it is always handy for the size you want. If you only want a piece 2 inches square, you don't take a half sheet and throw the balance away. A quick-acting vise placed about 6 inches from the end of the bench is all right—is quite handy. A glue kettle for each patternmaker often prevents a scrap.

VANDERBILT.

The Diamond Point Lathe Tool.

Editor American Machinist:

In his article, "Three Old Fossils," page 344, "Knocker" asks who invented the diamond-point tool, and rightly surmises it to be an evolution. But when he says it is a "survival of the unfittest" he certainly shows himself unfamiliar with the good qualities of a properly constructed diamond-point tool. As he partially states, the cutting action of a tool depends upon the angles of the rake and clearance principally, and on its contour. If it is a lathe tool, it also depends upon its hight relative to the lathe centers. Now, then, let us trace the probable evolution of the diamond-point, and determine if there is not some good excuse for its existence, which "Knocker" so emphatically denies. As a little experimenting will show, a tool that has its rake inclined back toward the shank as well as to one side, will cut very much better than a tool with side rake alone. Unless the tool has been upset on the end, throwing its nose above the shank, this back rake cannot be given it without sinking the corner of the grinding wheel into the shank. It is unnecessary to expatiate on the evils of such a process. Being convinced, however, of the large increase of efficiency obtained by back rake, it is only necessary to elevate the nose of the tool to get rid of the necessity of using the corner of the wheel.

This upsetting can be performed in no easier or more efficient manner than in the way it is done in a properly made diamond-point tool. Each side of the stock just back of the portion intended for the head of the tool should be necked with a fuller to a depth tapering from one-third of the thickness at the top to nothing at the bottom. First one and then the other of these grooves is placed over a corner of the anvil with the shank extending downward at the proper angle, about 40 degrees, and the front faces are drawn from heel to point, to the correct form. The form I have found to give the very best satisfaction has 20 degrees clearance on each of its front faces, which meet each other at an angle of 80 degrees, 15 degrees rake down toward the shank and 15 degrees to one side. These angles we obtain on a Gisholt tool grinder, a machine that we value as highly as does "Knocker." After this, the top and front faces are made concave, swept out to the same radius as the wheel of the ordinary water tool grinder, which in our case is 16 inches in diameter. These faces should show a continuous cut of the wheel from heel to point. The point is then rounded to not more than a 1-16 inch radius and the tool is hardened. This tool is intended to cut as high above the center as the clearance will permit, and after exhaustive experimenting I am convinced that it is an ideal roughing tool. The concave faces are of far more importance than is generally supposed. On the clearance it permits the cutting edge to be set perceptibly higher above the center without lessening the amount of strain it will stand in the new position. With the top face concaved, the stock is removed nearer tangentially and consequently with less power.

The round-nose tool which "Knocker" proposes to use in place of the diamond-point will not cut as smoothly and will require more power, even with the same rake. The chip from the side of the tool and that coming from the front end meet and tend to crowd back against the cutting edge, with the result that the chip is torn from the stock instead of being removed by a clean cut, as would be the case with a tool presenting a straight cutting edge to the work.

This subject of grinding tools is not given the consideration its importance deserves. Most foremen are inclined to ignore it entirely, feeling that they would be interfering in a matter personal to the lathe hand himself when atttempting to show him how his tools should be ground, but this, as well as other changes, can be brought about, with good feeling to all concerned, by the use of a little tact. I am very familiar with the villainous looking tool that is known to most shops as the diamond-point tool; but why blame the tool for its shape when the user is so unfamiliar with its possibilities that he doesn't give it half a chance? The Gisholt No. 17 is a fair substitute, and if twisted as the No. 20, bringing the strain nearer the center of the shank, retaining its straight cutting edge, it is still better.

W. H. M. "MINNESOTA."

Lead Laps.

Editor American Machinist:

On reading the article by "B." at page 482 I was slightly shocked to learn that lead laps are "poor excuses" and "require renewal after each hole." As "B.'s" experience in the lead-lap line seems to have been limited to having seen them, he must not blame one who has run lead laps some for coming to their defence.

Lead laps do not need to be renewed after each hole, but they will actually grow to keep pace with the hole if handled rightly. They also will lap small, long holes in cast iron, or the holes in a yoke or opposite sides of the frame for a small machine which can be finished by no other means as accurately as our work calls for.

In making a lap for a small number of holes, say six for the sake of exactness, my method is to make a free fit for the smallest piece, if there is any difference, bringing them up to the size of the larger holes and carry the whole lot along together; 90 emery is good enough on a lead lap. Roll it in with an old flat file, bearing on hard enough to thoroughly bed the grains in the lead. By this method the lap can be "built up" and kept cutting in a manner which is surprising as well as effective.

Three or four spiral grooves cut in the lap with a hand tool, or by any other convenient method will help the cutting qualities, by catching the chips and loose emery. Lead laps may be made adjustable if desired by molding on a taper mandrel having a half-round groove in one side to keep the lap from turning. Turn the lap to size and split one side clear through to the mandrel, when it can be enlarged by driving the mandrel in farther, with the advantage of enlarging the entire length evenly. WHEELER.

Fillets.

Editor American Machinist:

At page 639 "Old Bob," talking about fillets, says: "Wood fillets, if for use in right-angle corners, should be planed to 93 degrees angle." Now, dear Bob, pardon me, but don't you think it would be more educating to our young boys who are growing up in the patternmaking trade and for whom this article is intended, I suppose, to say: "After cutting the strips wanted for fillets, on the rip saw, take a shaving or two off so as to make a clearance on the bottom and have the edges of the fillets surely touch, then put on your glue—such as you have—stiff, limber, cooked, half cooked, any old thing; put the fillet where it belongs, and if there is a surplus glue on the edges, take a small handful of shavings, moisten in the glue heater and rub the glue off?" This is every-day, 1902, pattern-shop philosophy, and when you begin to talk about "stiff glue" you make me blush. Use the glue you have on hand. When you begin to look for special preparations in a pattern shop you can expect to find nothing but trouble.

My dear Bob, leather fillets are as old as I am, and this is my second trip on earth. I don't quite agree with your way of securing them to the pattern. I *always* use shellac and have found it the best way to secure fillets—wood or leather. The trouble I first experienced was that I tried to put the fillet in place too soon after I put the shellac on, but by laying the fillet flat side down, putting on the shellac and letting it remain a while until the alcohol has evaporated, and then putting it on the pattern, I had a good job. PLUMB BOB.

Some Pattern Shop Economies.

Editor American Machinist:

I will here mention some of those small things that aid in producing good work at a low cost, things that are often thought to be of little importance in shop management. The first and principal thing needed is a strictly modern equipment, and a man with brains in charge to keep it up to the most efficient standard. He will not be a low-priced man, but will be a cheap one if results are considered.

One of the greatest losses in the majority of shops is in the recklessness with which lumber is cut up. I have often seen a small piece cut out of a board because the workman has never been taught economy of material. One reason why the small pieces are not worked up closer is that they are not easy to get at, being thrown under benches or in out-of-the-way corners. I have in mind a shop that has three different scrap piles, and each so large that it doesn't pay to hunt a small piece out of it. In another place one of the apprentices takes care of all the small pieces and sorts them out in one place in the shop, the result there being that small pieces are easily found and the pile then never gets unduly large.

In segment work the use of eight segments will often save much material. Four are often economical; five are often as good as six and save making one joint. Some workmen seem unable to build a segment job with anything but six segments, and they possess no judgment as to how to cut lumber. I have seen patterns made out of the stock some men waste. I recall a case of this kind. A man glued up a pump ring, making it in two segments, or a half-ring. Another man in the same shop glued up another ring, slightly larger, out of the stock the first man wasted. I never saw his superior on segment work. I've seen him glue up and turn a job before another man would have a similar job glued up.

Another habit of the average workman is to rough out his stock unnecessarily large, the result being that when he cuts his job to size he has a piece left that should have been left in the plank. In cutting out pieces that have large and small parts, put the large parts next the small ones, instead of roughing out a block as big as the largest dimension, to be afterwards cut down with a lot of stock wasted.

The highest quality lumber is often used for cleats, stop-off ribs, heads, etc., when the commonest at half or one-third the cost would do just as well. I've seen men carefully cut a knot out of a piece that could have been left in as well, and I've seen patterns glued up solid that would have been better with half the lumber in them and would have taken less time to make them.

There are many patterns made far better than necessary, owing to lack of directions on the foreman's part, or of judgment on that of the workman. Orders can never be too explicit. There are shops in which the misdirected efforts and useless work take a large slice off the profits. A clean, orderly shop conduces to cleanliness and order in the workman. Good machinery kept in good order makes him feel that his employers are trying to help him do a day's work. One of the most discouraging things to a good, energetic workman is to be unable to do a day's work on account of poor machinery in equally poor condition.

Supplies should be kept on hand and be easily accessible. It is poor policy to have a workman wait for anything needed on his job. Supplies should not be allowed to be wasted or used unnecessarily. A cheap man should not be put on first-class work, nor a first-class man on cheap work. Varnishing, puttying and filleting should go to the apprentice; it is poor economy to have a $3.50 man do varnishing.

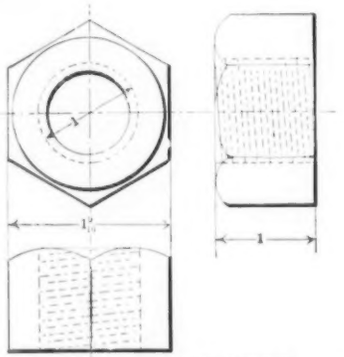
J. L. GARD.

Compressed Air in a Barber Shop—How a Watch Was Cleaned.

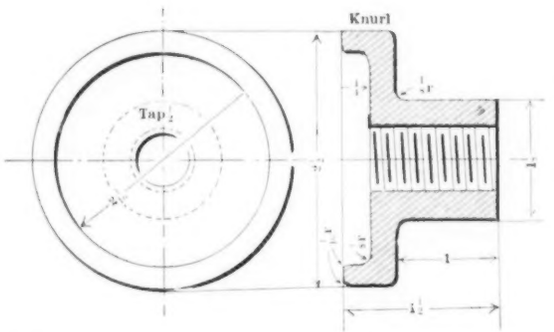
Editor American Machinist:

I wish to relate the following which took place in a barber shop and which may be entertaining and instructive to the readers of your paper. Among a number of men waiting in a barber shop for "Next" was an Irishman who saw the barber spraying and drying a customer's face with the compressed air. He was very much interested, and after asking a few questions he said: "Begor, I think that is a good thing to knock the dirt out of an ould watch," at the same time handing his to the barber to clean. The barber saw that the watch was a cheap one, and would not amount to much loss if spoiled, so opened the back of the watch and turned on the air. The cleaning was done about six months ago, and about a week ago I saw the owner of the watch and the barber. The owner said the watch kept good time and gave no trouble, and the barber said that he had cleaned about half a dozen watches since. I am not posted enough on watches to say that this is a good way to clean a watch, but if you have an old cheap watch you can't be at a great loss to try it. D. E. M.

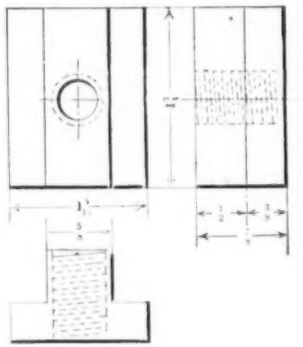
NUT. m. steel.fin.& C. H.



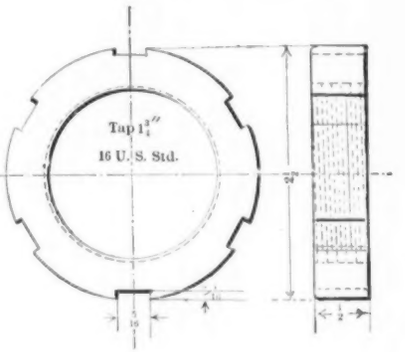
HAND-NUT m: steel.fin.



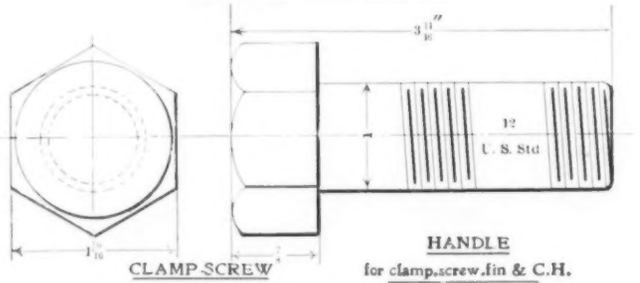
T-SLOT-NUT. m. steel.



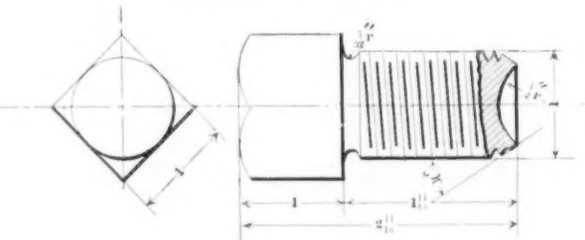
NUT. m. steel.fin.& C. H.



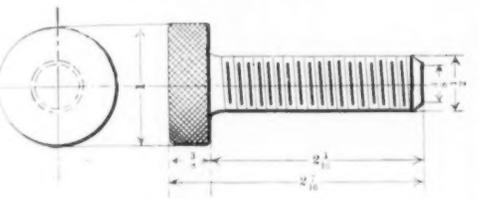
CAP-SCREW m. steel.fin.& C. H.



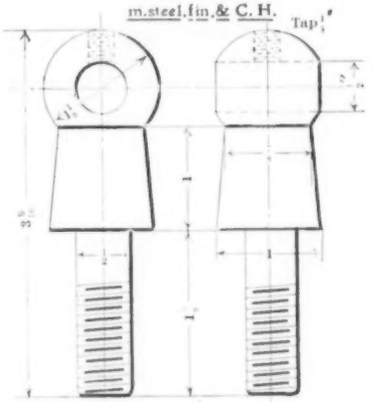
SET-SCREW. m. steel. C H



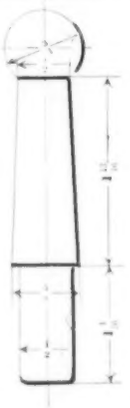
THUMB-SCREW m. steel. fin. & C.H.



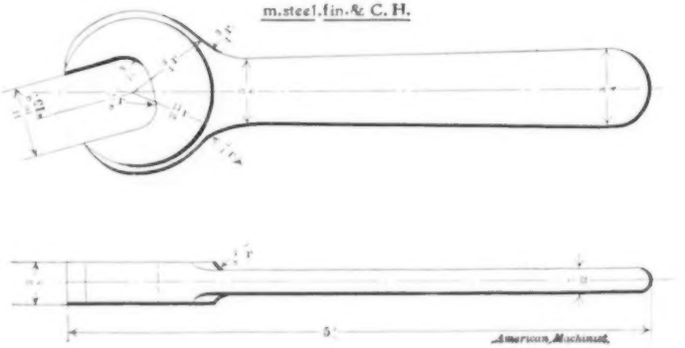
CLAMP-SCREW m.steel.fin.& C. H.



HANDLE for clamp.screw.fin & C.H.



WRENCH m.steel.fin.& C. H.



FORGING DETAILS.
Oct. 1901
E.C.P.

REDUCED FAC-SIMILE OF PLATE VI.

The Methods of Conducting a Shop Drawing Class.

The method employed in teaching mechanical drawing in the factory of the Cleveland Twist Drill Company was mapped out more with a view to teaching the employees to read drawings than to make draftsmen of them, but at the same time so that those who cared to follow the profession in the future would be able to use all the information and practice to good advantage. No originality in plan of teaching was attempted, but a combination of two methods might be said to have been used.

An admission fee of 50 cents is charged, with a view to making the pupils feel that they have an interest in attending regularly, and to partly pay for the drawing-boards, blackboards, light, etc. Each pupil purchased his supplies of the company at cost, and by buying a number of sets of paraphernalia they are enabled to get reduced prices.

The blowing of the whistle in the evening is the signal for class to assemble (after washing up) in the dining-room, where they are served with a light luncheon in shape of sandwiches, tea and coffee. One of the long tables at the other end of dining-room constitutes the desks of the pupils; a large portable blackboard faces this within easy reading distance. The class consisted of twenty pupils who had been through fractions and percentage in arithmetic, but further than this knew nothing of mathematics, so that all subjects touched upon in class requiring a more extended use of mathematics had of course to be postponed until such time as they were ready to handle them intelligently.

Upon organization I found some had taken lessons previously in drawing, knew the use of different instruments and understood the ordinary geometrical problems occurring in drawing, while others were without any such previously acquired knowledge. This would have meant two or three classes, and as I could give only one evening a week, I decided to teach by plates very similar to the correspondence schools, which enabled each one to be in a class of his own if necessary, and as very little drawing could be done in one evening in a class they were instructed to do all drawing at home. This gave the entire evening to oral work and lectures. Each pupil was furnished with a blueprint of instructions such as would be needed outside of class, and also a plate (blueprint) to copy from. These plates were drawn, then blueprinted, but to a scale of about 10 inches to the foot, so that no copying by dividers could be done. The first four contain the ordinary geometrical problems, the next four projection, cylindrical and conical intersections and developments; then came the simple machine parts to teach the correct placing of views, shading, etc. From this on the plates gradually get more intricate and complicated, but in all cases are taken from our own shop drawings or a machine in the factory, and more especially is a drawing of a jig or fixture used which may have given any trouble to the machinist to read. These drawings are then made at home and left in the drawing office, where they are corrected and marked, a record of the progress of the student being kept for reference.

Upon the opening of class the roll is called, and a certain portion of time is taken up each evening in answering any questions pertaining to any of the plates or work gone over. In the beginning of the term students were sent to the board and asked to show the projection, shade lines, etc., of a given piece with a view to ascertain if they understood the instructions and plates. Later they were given a little algebra in the shape of simple formulas; which, by the way, gave most of them some trouble until they got to handle the characters as though they had no value, or to treat them by the rules regardless of their value. One of the hardest things to get clearly fixed in the pupils' minds was to algebraically subtract a larger number from a smaller or from 0. Of course the time was so short that a thorough course in algebra was out of the question, therefore simple formulas with one unknown quantity were all that were attempted. When these were handled readily the solution of right-angle triangles by the use of trigonometrical functions, and practical applications of the same as used around the factory were taken up.

A short course in the practical laying out and working of gear problems came next, which gave very little trouble, as most of the students were more or less familiar with the subject.

This year's course in class closed with logarithms, and considering that I left the theory of exponents out of the question, taught them only the use of the tables and gave them rules to solve the different examples by, they handled the subject remarkably well. It was always evident to a visitor in the works that there was a school in progress, as the numerous blackboards in the dining-room were always occupied in the dinner hour by students working out different problems that occurred from day to day, and I was extremely well pleased to notice on the different boards the character of the examples chosen and the intense interest which the students seemed to have in the subjects. Scarcely a day went by without a pupil inquiring why a view of a drawing was given this way, or what a certain line represented; showing that they did not merely copy plates, but were actually drawing the object with the plate as a help.

Of course some pupils made more progress than others and better drawings, but this was to be expected, as some are more apt than others and everyone has not the same time to put upon the lessons; but as a whole the class was a success.

I enclose to you Plate VI, the first one of machine parts, merely to give you an idea of the work, and would say this was the starting point of that part of the class which had been through the geometrical and development drawings.

EUGENE C. PECK,
Mech. Engr., Cleveland Twist Drill Co.

Boston Meeting of the American Society of Mechanical Engineers.

The forty-fifth meeting of the American Society of Mechanical Engineers opened on Tuesday evening, May 27, in Huntington Hall, Rogers Building, Massachusetts Institute of Technology. Francis H. Boyer, of Somerville, chairman of the General Entertaining Committee, welcomed the members and introduced the various speakers. The first of these was President Henry S. Pritchett, of the Institute. Mr. Pritchett's address of welcome was very cordial and complimentary, dwelling particularly upon the advantages of a technical education and training supplemented by that training which is obtained only in the actual practice of engineering. He took occasion to commend the quality of what he called a Boston welcome—saying that he had himself recently experienced one and could therefore certify that there was no warmer or more cordial welcome or one that conveyed more meaning to guests. Speaking of the results of technical instruction, he said that it was impossible to predict in what way an imparted truth might affect the recipient or his work, and related some curious incidents that had come within his observation, mentioning, for instance, the fact that among the men who had recently graduated from the M. I. T. engineering course were two successful clergymen, and he related the case of a man who addressed a meeting of fellow graduates of a technical institution in Cincinnati, which meeting Dr. Pritchett was attending. This speaker spoke in such very high terms of the instruction that he had received that at the conclusion of his address Dr. Pritchett inquired what branch of engineering that gentleman was following and was informed that he was an undertaker. Of course, Dr. Pritchett's address did not hold out the idea, however, that technical education commonly results in such curious ways.

The next speaker was President George A. Kimball, of the Boston Society of Civil Engineers, which society was organized in 1848 and is said to be the oldest engineering society in the United States. Mr. Kimball called attention, especially, to the numerous examples in and around Boston of notable work which had been done by members of the A. S. M. E., mentioning especially a number of large engines which had been designed by and built under the supervision of President Reynolds. Finally, Mr. Kimball made a plea for closer

association and co-operation between civil and mechanical engineers—a plea which it might have been advantageous for some engineers in New York who oppose a joint engineering society house to have heard.

In the absence of President Reynolds, who was detained at home by illness, James M. Dodge, the senior vice-president of the society, responded to the addresses of welcome, and in doing so took occasion to compliment particularly the work and services of such young men as are being turned out from the M. I. T., saying that in his own experience he had been astonished to observe the character and quality of the work undertaken and successfully carried out by such young men. He described the older "rule of thumb" procedure in doing engineering work with the present methods of scientifically trained men, to the great advantage of the latter, and his address, interspersed with flashes of wit, was very well received.

Many ladies were in attendance at this first session and a little variation from the usual program took place in the form of a very enjoyable reception which was held in the library below the auditorium, where refreshments were served, ladies of the Ladies' Reception Committee presiding at the tables.

WEDNESDAY MORNING'S SESSION.

The opening of the session on Wednesday morning was about half an hour late, and Acting President Dodge, calling attention to this and to the limited time available, reminded the members of the existence of rules limiting the time for the presentation of papers and discussion of them, and took a vote of the members present as to whether these rules should be rigidly enforced or not; the result being a unanimous vote in favor of such enforcement; after which the secretary presented the report of the tellers of election and then read an invitation from the secretary of the American Section of the International Association for Testing Materials, inviting members to attend the meeting of that section to be held at Atlantic City this month.

Under the head of new business Fred J. Miller offered a resolution providing for a letter ballot of the members upon proposed amendments to the rules, stating that he introduced the resolution by request, and that it was intended to facilitate the work of the committee to be appointed under a resolution not yet offered, but which he understood was to be offered and which would provide for the appointment of a committee to consider suggestions from members and to formulate constitution, by-laws and rules of the society. C. W. Baker stated that he was in sympathy with the proposed resolution, but called attention to the fact that at the meeting last fall in New York he had offered a similar resolution, having the same object, which resolution, after some amendment, had been accepted for presentation to the society at the meeting next fall. He could not now withdraw that resolution and he thought that in some points it was superior, because it required that an amendment submitted to the members should first run the gauntlet of the Council or of the members attending a meeting, so that the society would not be put to the expense of sending out letter ballots upon every trivial amendment that might be offered by members. After some further discussion as to the course the new resolution should take, it was accepted to be voted upon at the fall meeting in New York, under the rules, after which Henry R. Towne presented a resolution calling for the appointment by the acting president of a nominating committee to name a committee to revise the rules, etc., and to report to the society not later than October 15, or in time so that the result of its work could be mailed to members before the annual meeting. C. W. Hunt thought that the time mentioned was too short; that such work should not be hurried, and that more time would be required than the resolution provided for. Mr. Towne, however, thought that some sort of report could be made on that date and that it was rather important to get ahead with the work as rapidly as possible, in view of the fact that under the rules any recommendations made by such committee could not be adopted before the fall meeting in 1903, or, in other words, about eighteen months hence. The resolution was thereupon agreed to.

COUNCIL'S REPORT.

Further in the consideration of new business, Mr. Miller stated that he had understood that the report of the Council, which had previously been distributed to the members, was not to be formally presented at this meeting. Appended to this report of the Council were the reports of the Finance Committee, of the Executive Committee, of a Joint Committee composed of the members of these two, and of specially appointed appraisal committees; all, taken together, setting forth the actual condition of the society and making recommendations for its future guidance. The report of the Joint Committee, composed of Arthur M. Waitt (chairman), Edwin Reynolds, Milton P. Higgins, Wilfred Lewis and F. R. Hutton, of the Executive Committee, and Stephen W. Baldwin, Fred J. Miller, C. W. Hunt and R. H. Soule, of the Finance Committee, showed that a very great deal of carefully considered work had been done, with the result that the society's methods of accounting had been completely renovated and greatly improved, an expert accountant having been employed for that purpose, and his work having been under the direction of H. R. Towne, whose report to a sub-committee is also given. This report, having been printed some time in advance of the meeting and a copy of it sent to all the members, it is needless to abstract from it at this time.

The most important feature of it, perhaps, is the resolution of the Finance Committee recommending that a special committee be appointed to revise the rules of the society and formulate for it a Constitution, By-laws and Rules, which resolution is reinforced by a resolution of the Joint Committee, but is not included among the recommendations made by the Council "for the future."

The Council does recommend, however, that the members carefully consider an increase of dues to $20 per annum for members; $10 for Juniors for the first two years, with $1 increase annually thereafter till $20 is reached, and an increase in the fee for life membership proportionately.

Upon this report Mr. Miller spoke as follows:

I think it will be agreed that this report, in which the Council (I am tempted to say for the first time) takes the members of this society into its confidence and places before them a complete statement of the society's affairs, forms an excellent basis for intelligent action by the membership; and this confidence, I am persuaded, is not misplaced. This society is composed of grown men, most of whom are more or less trained men of affairs and those qualifications which entitle them to membership entitle them to know, to discuss and finally to decide upon matters of business connected with the society. Indeed, I could wish that the report might have gone further and still more into detail and that we might have been informed, for instance, not only what the ratio is between our expenditure for the secretary's office and that of other societies, but also just what amount we do spend. I think there should be no secrecy whatever about that, but that every member should be considered entitled to know all about it.

There are a few points in this report to which I desire to call attention and concerning which it seems proper to ask a few questions: At page 3, under the heading B and paragraph No. 2, the statement is made that during the twenty-two years of the society's existence it has accumulated a surplus of over $73,863. It is evident from this that the average receipts of the society have exceeded its average expenditures by about $3,350 per annum. If, during the past few years this annual surplus has been turned into a deficit, then it is the part of wisdom to carefully consider the reasons therefor an then to consider whether the increased expenditure per member is wise or necessary, and I have no doubt that a majority of the members would favor such increase of dues as had been shown to be clearly necessary after proof that the society's affairs have been for a time well managed—managed in a business-like manner, but not otherwise.

As regards that part of the report which refers to the society's former and newly

adopted methods of bookkeeping, under heading C at page 4, it may be observed that, while the present method is adapted to give the officers and members a much better and clearer idea of our pecuniary affairs than was readily obtainable previously, yet the fact is, as one member expressed it, that "a balance sheet is not a new or modern invention"; on the contrary, it is an old familiar thing, the very great usefulness of which has been amply demonstrated through many years of business experience.

. . . . . .

Under heading D at page 5, the character of the published volumes and the quality of the papers printed by the society are referred to, and it is stated that "so far from curtailing these the society should expand in the direction of more papers of wider interest, of superior quality and usefulness, even if it must expend something more to attain these results." I think every member will agree that an improvement in the practical usefulness of the papers presented before this society is desirable; but can such improvement in the papers be secured by the mere expenditure of money? It seems to me doubtful, but possibly different, though not necessarily more expensive, methods might readidly bring about such an improvement.

. . . . . .

Though the conclusion of the Council as expressed toward the latter end of this paragraph will probably be accepted by many, I think there are many other members who will not be disposed to accept it as the final conclusion. There is a quite prevalent and perhaps growing conviction that this society will never be able to do all that it should do, nor to develop the degree of usefulness it should develop, or might develop, until it has a secretary who is not only efficient and business-like, but who can devote his entire time to the affairs of the society, and will have no other interests which he may consider paramount. I do not pretend to say whether this view is correct or not—and indeed I am not yet satisfied in my own mind regarding it—but this much I feel sure of—*i. e.*, that the question should receive careful attention and the views of the members should be obtained and considered in relation to it. I think it will be found that, generally, they will be less interested in knowing whether or not we pay more or less than another society, than in knowing whether or not we are doing the best that we can do.

At the beginning of paragraph No. 3 on page 6, the cost of operating the society's house is given as $3,783 per annum, and figures are given to show that the minimum space that would be required in which to do the business of the society would cost nearly as much if rented, and perhaps more. I doubt if there is as much profit in the mere renting of property in New York city as these figures indirectly show. Without going into figures at all, it seems on the face of it that the maintenance of this house is an expensive luxury, and the figures given are not, I think, sufficient to dispel this impression. I believe the amount stated as the net cost of operating does not include interest. Certainly the interest actually paid out on the mortgage indebtedness should be included, and in fact interest at, say, 4 per cent. on the entire valuation of the property should be included, and 4 per cent. of $85,000 = $3,400 should be added, making the total net cost nearly double the amount given. Admitting the force of what is said about the advantages of the society owning its own house, the question is still open as to whether we are not paying rather dearly for these advantages—especially when it is considered that the house has become totally inadequate for its chief purpose.

Near the top of page 7 it is explained why the cost of operating the society per member does not fall so rapidly as it would, or might, under other circumstances. Of course we all understand that where fixed charges enter into an expense account, expense per capita cannot be reduced in proportion to increase of membership; but as a matter of fact the report indicates that the expense per member has not fallen at all within the past few years, but has increased, and the members of the society will, I believe, generally not be entirely satisfied until that increase is satisfactorily accounted for, and probably not until the increase is arrested.

Referring to the second paragraph under heading "E," which are recommendations for the future, I believe that no member of the society believes that it should, in the language of the report, hold its breath and mark time and fail to progress. It is simply a question of how we should progress or in what way we should progress. Rightly or wrongly very many members now believe that we were, last fall, in danger of attempting to progress along a path in which no real or satisfactory progress would have been possible. They believe that the Council was led to inadvertently approve measures which not a single member of that Council would have considered for one moment in connection with his own business, where he alone would have been responsible for the results. It does not follow that these members—sincere well-wishers of the society, I am sure—are in favor of the society's holding its breath and marking time simply because they do not think it is wise to follow a certain specified course. My belief is that the quality of the transactions can be improved without materially increasing the cost of them, and it is open to debate, doubtless, as to whether we do not publish a good deal of matter that is of little value. Those who are at all acquainted with the printing business know that tables in printed matter are an expensive luxury, and it is doubtful if any large proportion of the members of this society derive much benefit from many of the expensive tables giving long detailed accounts of tests of engines and boilers which so abound in our transactions. Perhaps the gist of these things might in many cases be given without publishing page after page of long tables which are of doubtful value, and much the same may be said of fully worked out mathematical demonstrations.

The best and perhaps the most hopeful feature of this report is to be found in paragraph 7 at page 16, where the Finance Committee recommends that a committee be appointed to make a general revision of the rules of the society, etc., and in favoring such a resolution I do so because it will enable any member who desires to present to this committee, either in person or by mail, such changes or ideas as may seem to him calculated to increase the society's usefulness or improve its standing. This committee, then, may take all such ideas under consideration and may formulate proper constitution, by laws and rules to be submitted to the members for their approval, amendment or rejection. The right of voting by proxy having been established, every member of the society may feel sure that the wishes of the majority of the members can be carried out.

The Chair remarked that this was just the kind of comment desired and needed, and that the Council would be very glad to have the members express their views freely on matters connected with the business of the society.

Mr. Towne called attention to the fact that a portion of the surplus revenue mentioned in the report and referred to by Mr. Miller arose from the increased valuation that had taken place in the society's New York house, or, in other words, to what the speaker said Henry George called the "unearned increment." Mr. Towne stated that during the past six and a half months the debt of the society had been reduced by $3,000.

Jesse M. Smith said that a good deal had been said regarding the financial affairs of the society, but he thought that there was a more important side, and that is the engineering side. He thought there should be no curtailing that would in any way interfere with the usefulness of the society. In that connection he offered a resolution providing for the free distribution of papers, in advance of the meetings, to all members of the society, as had been the practice until recently, when it was changed by order of the Council as a measure of economy. In support of this resolution, he cited the experience of the Civil Engineers' Society, which had formerly not printed its papers in advance, had afterward printed a few in advance and sent them out to such members as it was thought might be especially interested in them, and now was sending them to all

the members in advance and in time for discussion; the result being that the length of the papers presented had increased 50 per cent., and of the discussion upon them 141 per cent. These figures seemed to amuse the audience, and it was rather evident that so far as these statistics were concerned, the members present considered them rather an argument against sending out advance copies than in favor of such sending.

After the resolution had been seconded by Mr. Supplee, Harrison Emerson took the floor to remark that organizing talent was one of the most important for engineers to possess, but that he thought the management of the American Society of Mechanical Engineers was a very poor example of such organizing talent. He criticised the management of the society vigorously and stated that in his opinion, formed after considerable study given to the matter, an economy of at least $10,000 per year could be effected without in any way interfering with the efficiency and usefulness of the society. He thought that before discussing such matters as sending out papers, the first thing to do was to "put our house in order." The society had, he thought, been attempting to run its house in New York as a gentlemen's club; as such it was a failure; it was not satisfactory as a club, and he believed that considerably more revenue could be derived from it by reducing the charge for rooms. He expressed the opinion that the expenses of running the house could be considerably reduced and that, in short, its efficiency as a club was at present about 28 per cent., which he thought was entirely too low. Mr. Emerson thought, also, that considerable saving could be effected in printing bills and that 25 per cent. of the society's income was entirely too large a proportion to be expended in salaries. He considered that as good services could be secured for much less money.

Mr. Kent objected to the character of some of the papers presented and thought that a much closer scrutiny should be exercised, many papers having been published which in his opinion ought not to have been admitted to the "Transactions" and that were in fact the opposite of creditable to the society. Mr. Nason stated on this point that there was at times considerable difficulty in getting papers of any kind and that it therefore seemed necessary at times to accept such papers as could be obtained. This sentiment, while it was not openly discussed, seemed not to be well received by the members, and it is probable that some of them considered that where papers of a desirable character could not readily be obtained it would be much better to reduce the "Transactions" and to print only such as were desirable, thereby saving the expense of printing, binding, etc., proportionately. Col. Meir thought that all the members who could make use of the papers should have them freely, but he did not believe the society should be at the expense of printing and mailing papers to go into the waste baskets of the members and thought that requests received by the society for copies of the papers might form an excellent guide as to the desirability of papers of a certain class and thereby lead to the exclusion of papers that were of little use to the members. He thought, too, that some of the papers were of an advertising character and would not have been published in any trade paper at less than about 25 cents per line.

Mr. Almond stated that it was a question of whether the society should continue to exist at all or not. If it kept on getting in debt it was evident that it could not exist. He said that for his part not one paper in one hundred was of any interest or use to him, and he saw no propriety in the full list being supplied to him regardless of his preferences.

Mr. Ashworth spoke eloquently in favor of going on without curtailment of expenses or "cheese paring," as he termed it; dwelt upon the high position the society should occupy; thought that it should be unstinted in its expenditures, but threw no light upon the methods by which this might be done under the present circumstances.

Mr. Towne said that this was one of the most profitable meetings in his opinion the society had ever held; the society, he thought, needed a re-awakening; that members must be aroused and their interest awakened in the society and its affairs; that this must be done by the members themselves, the society having been for some time drifting, so to speak, the members leaning upon the Council and the Council leaning upon the secretary. The present report of the Council now under discussion he cited as an example of the way things had been going; several members in the Council not having had an opportunity to read the report before its issuance, with the result that it contained, in his opinion, errors of fact and of opinion. He thought that members should suggest and that things should not be measured by the dues. Work must be done and conditions secured which money will not buy; and, first, there must be good business methods and the strictest economy. The question being called for at this point, Mr. Towne earnestly expressed the hope that no mandate would be issued compelling the Council to rescind its action regarding the distribution of papers. This action, he thought, had been well considered; the Council had given it careful consideration, and had deliberately decided that it was desirable to make the change and ought not to be compelled to retrace its steps immediately; the speaker evidently fearing that the audience would be disposed to adopt Mr. Smith's resolution. This fear was, however, soon shown to be unfounded when Gus C. Henning rose and said that in view of the Council having given this matter careful consideration and arrived at what he believed to be a wise decision, he moved that the resolution be tabled. Such a resolution being not debatable, it was immediately voted upon and the motion to table was unanimously adopted.

At this point Mr. Henning, under the head of new business, stated that he had looked up the record of the appointment of the committee of the society that has been opposing the metric system and found that it had been appointed for the purpose of "gathering material to be used in opposition to the enforced adoption of the metric system," and that it was not authorized to represent the society in opposition to the metric system. Neither was the secretary authorized to write to a Congressional committee, as he had done, on the letter head of the society, opposing the metric system, as though representing the society in that matter. Mr. Henning pointed out that these acts of the committee and of the secretary were directly opposed to the well-established usages of the society, and offered a resolution excusing the committee from further service, which resolution was adopted by a unanimous vote.

At this point reports of standing committees were taken up, the first of these being

Final Report of the Committee Appointed to Codify and Standardize the Methods of Making Engine Tests.

The final revision of the report made after embodying the discussion at the Milwaukee meeting and at the New York 1901 meeting. Starting with a statement of the object of an engine test—the determination and comparison of the amount of steam, fuel or heat consumed and the amount of power developed—the report goes on to state that the problem before the committee is to determine "how to determine these quantities and to systematize the work in such a way as to serve as a standard method of test."

In the selection of units it is pointed out that "the only unvarying unit expressive of the energy consumed is the 'heat unit,' and we believe it is a foregone conclusion that the standard of comparison for all heat engines should be referred to heat units." At the same time "the hourly weights of coal, gas, oil or other fuel, or weight of steam consumed per horse-power heretofore commonly employed should by no means be abandoned. There is no conflict here with the proposed new standard. In the scheme presented by your committee these various additional or subsidiary forms of stating efficiency, as applied to particular classes of engines or kinds of service, are suitably provided for."

As one of the subsidiary forms of expressing efficiency, the so-called "standard coal" unit is chosen, the term "standard coal," meaning a coal "having a calorific value of 12,500 British thermal units used

in what may be termed a standard boiler, which gives an efficiency of 80 per cent. (referred to coal)." In other words, the term means a coal which imparts to the steam 10,000 British thermal units for each pound of dry coal consumed.

The tabular arrangement of data recommended is given and suitable attention is paid to commercial tests—that is, coal tests of the combined engine and boiler under the conditions of use.

Several long written discussions of this paper were presented by the secretary, most of them agreeing to the main points of the report and complimenting the work of the committee highly, but occasionally calling attention to points which the members though might possibly be improved or might be open to misunderstanding. Prof. Jacobus, who presented the report, stated that all these criticisms would, he felt sure, be entirely welcome to the committee, which would carefully consider them and incorporate such of them as seemed advisable in the report. Mr. Kent inquired if it was to be understood that this was not, then, after all, the final report of the committee as its title would seem to indicate, whereupon he was directed by Prof. Jacobus to note that at the head of the paper it said, "Subject to revision." One of the points brought out in the discussion was by Prof. Spangler, and referred to compound indicator diagrams; Prof. Spangler stating unequivocally that there was no possible use for such diagrams; that the only information they conveyed was as to how they would look when combined, absolutely no useful information being derivable from them that could not be obtained from separate diagrams in half the time and at a great saving of labor.

A "Supplementary Report of Committee on Standard Pipe Unions" was then presented, a sketch being placed upon the board showing a section of a union which had been recommended by the committee previously and was criticised in some of its minor parts by a manufacturer, whose letter was read. This led to some discussion of the use of soft packing or gaskets for high steam pressures.

W. D. Forbes objected to the form of union, which had a shoulder projecting through the packing inside the ring for the purpose of holding it in place. Mr. Forbes said that in using such a union for high-pressure steam the shoulder or support for the gasket should be placed outside the gasket or packing to resist the outward pressure of the steam.

Mr. Nason objected to this, that it was not proper to use fittings provided with soft packings for high steam and that the best practice called for metallic joints and where such joints were made to include a section of a sphere there was no trouble with them, the spherical surfaces allowing for adjustment.

At this point the presiding officer called attention to the fact that the reception committee had provided luncheon for the members of the society in the adjoining room and that as the time for this had arrived it would be necessary to defer consideration of the other reports until the evening session. Before adjournment, Mr. Woodbury on behalf of the local committee stated that the trustees of the Museum of Fine Arts had for the first time opened the museum for a reception such as was to be given the society; that about 400 Boston people had been invited to meet the members there and that, owing to the large registration the applications for tickets and cards of invitation had been so numerous that it was probable some restriction would have to be made. Tickets of admission would be necessary; these could be obtained by members, but not by others except upon a written recommendation of a member, which recommendation would be acted upon by the committee, favorably so far as possible. Adjournment was then had for luncheon where discussion of the society's affairs proceeded among the members, the general feeling seeming to be one of hopefulness concerning the outcome of the present discussion. The belief seemed to prevail that the society was not at all in a bad way, but that on the contrary it was getting itself into a position to increase its usefulness to its members and its standing in the engineering world.

WEDNESDAY AFTERNOON.

The afternoon of Wednesday was appropriated to visits of inspection to the various departments of the Massachusetts Institute of Technology. A number of guides acted to supervise parties of ten or a dozen each—the routes taken by the different parties being unlike in order to prevent their becoming mixed. The various laboratories, especially the one devoted to mechanical engineering, were looked upon with great interest, as their equipments are unusually complete.

WEDNESDAY EVENING SESSION.

This session was opened by some remarks by Lieut. Carden, of the United States Revenue Service, and also an officer of the forthcoming Louisiana Purchase Exposition, who was given the privilege of the floor in order to explain some feature of the forthcoming exposition, such as the absence of any charges for space, power or crane service and the measures that are being taken to protect exhibitors from extortion of any kind.

The first regular paper taken up was

Specifications for Steel Forgings, Steel Castings and Steel Boiler Plates.

By William R. Webster.

This paper is a compilation of the specifications prepared by the American Section of the International Association for Testing Materials. They are presented in the present form for the purpose of consideration and discussion. Under each of the three classes of materials the specifications are given in detail as to the process of manufacture, chemical properties, physical properties, form and sizes of test pieces, methods of testing, finish and inspection. The committee of the American Section has its annual meeting at Atlantic City, June 12, 13 and 14, hence the pertinence of any discussion of this paper by the society at this time.

In the discussion Mr. Vauclain objected to the specifications in writing, because in his opinion the methods were too cumbersome for everyday use. He thought that the society should appoint a committee to prepare a set of specifications of this kind. Mr. Henning criticised the paper in a lengthy written discussion, in which he enlarged upon the difficulties involved in keeping such specifications clear from commercial interests. He considered the specifications submitted to be very defective. In his opinion they prescribed material which should not be used at all, and in many respects they were opposed to the interests of the user. The test pieces and specimens recommended he considered to be representative of the practice of twenty-five years ago, and to be not only behind the times but to indicate ignorance on the part of the compilers of the advances made in the art of testing materials in recent years, especially in Europe. He considered the specifications defective in that they do not define the grades of steel with any accuracy; in that the bending test prescribed is very unsatisfactory, and especially in that the short 2-inch test piece recommended for tensile tests is very unsatisfactory in many ways. In addition to these points the terms elastic limit and yield-point are nowhere clearly defined, and the method of their determination by the drop of the beam is so defective that it should be no longer used.

Professor Lanza thought that while there might be some excuse for the use of the short test piece in the case of some forgings, there could be no excuse whatever for its use in testing steel castings.

Mr. Webster, in reply, stated that the specifications were intended to represent American and not foreign practice. The committees from other countries could be depended upon to uphold their national practices as this committee had done. He defended the short test piece as being the piece used by the United States Government under the sanction of Commodore Melville.

Following this came a paper entitled

Tests of Steam Pipe Coverings.

By Geo. H. Barrus.

This paper describes the series of tests conducted by the writer at the new power house of the Manhattan Elevated Railway which we noticed while they were in progress. The tests were more practical than is usual with work of this character and the results may be regarded as reliable and are a valuable addition to engineering data. Numerous diagrams and tables of permanent value are embodied in the paper.

In the discussion, Mr. Crosby regretted that the tests had been limited to sectional coverings and that the so-called plastic coverings had been omitted. It is necessary to use these plastic coverings on a considerable proportion of pipe surface, and knowledge of their properties is therefore important. Professor Jacobus referred to some experiments of his own on the same subject, in which many of the same coverings were included, and he gave upon the blackboard comparative tables of the efficiencies obtained in his own and Mr. Barrus's experiments, which showed a very satisfactory agreement. Mr. Kent called attention to the, comparatively speaking, small differences in the results obtained with different coverings.

Following this came a paper on

Elevator Safeties.

By Charles H. Pratt.

Millions of people ride daily in elevators, and it is an important function to make them ride safely. Most elevator accidents are due to derangements of the elevator machinery and not to the breaking of the ropes, so that to depend on the slacking of the rope to actuate the safety will not do. It must be done by the gripping of a rail, and centrifugal force due to the acceleration of descent is the best actuator. The paper discusses the defects of devices which embody these principles and then describes the device of the writer, which is asserted to avoid these defects and to have stood the most exacting tests. The device cannot be described in detail without illustrations. It embodies a most simple and reliable centrifugal governor, it has the stored energy of a spring to bring the gripping jaws instantly in contact with the rails and the pressure steadily increases through any distance necessary to stop the car with ease and safety. It has been tested up to 800 feet per minute and with loads of 5,000 pounds.

Mr. Pratt presented his paper in abstract, the illustrations being thrown upon the screen by the aid of the stereopticon. The paper received no discussion, and the meeting proceeded to consider a paper on

Recent Construction at the Atlantic Avenue Station of the Edison Electric Illuminating Company, of Boston.

By I. E. Moultrop and R. E. Curtis.

This station, a pioneer among stations employing vertical engines with direct-connected generators, has recently been greatly enlarged, and a number of new features have been introduced which are more or less peculiar to it. In this paper is given a brief account of some of these features, and of the conditions under which they were developed.

The peculiar shape of the property available has favored an arrangement dictated by considerations of prudence and convenience in operating. The complete station is therefore subdivided into two engine-rooms, two boiler-rooms and a switchboard room, communicating conveniently with each other but capable of instant and complete separation each from the other.

Around the original switchboard as a nucleus has grown the present switchboard room, surrounded by substantial brick walls, and with fireproof internal construction.

The main steam system has been radically changed. Instead of an elaborately interchangeable system, a "unit" system has been adopted, one or more engines being directly connected to a group of boilers, the various groups being interconnected sufficiently to meet all probable operating conditions. By these changes the size of pipes and number of valves were considerably reduced, and advantage was taken of the opportunity to utilize improved modern materials and the most approved safeguards.

A central condensing system was also installed, designed to serve ultimately the new station and part of the old. Notable features of this system are the arrangement of the condensing machinery, utilizing an otherwise waste corner, and the 50-inch riveted steel exhaust main extending around the engine-room. This plant is giving very satisfactory results in operation, though not yet fully loaded, and the absence of condensing apparatus, piping, etc., from the engine-room has marked advantages.

Beginning with 1899 all new boilers have been provided with superheaters, until more than half of the boilers now in service are so equipped. Of course, the full benefit cannot be obtained under such conditions, but a gratifying improvement in economy has been registered, being more marked in proportion to the directness of connections between engines and boilers, and the freedom from admixture of steam from the non-superheater boilers.

The coal handling system is also touched upon, a more extensive and elaborate plant than the station alone would justify having been made possible by co-operation with a large local retailing concern. A prominent feature of this plant is the new electrically operated unloading tower, which presents several novel details.

Mention is also made of the steps taken to provide power operation for the large (24 to 48 inch) valves at the station, of several minor details of construction, and of certain local conditions influencing design.

In the discussion, Mr. Morse noted that the paper expressly stated that satisfactory results had been obtained with the super-heaters, and he wished to know if they had been critically examined to determine if pitting had occurred. In reply Mr. Curtis said that they were under constant inspection and that no deterioration had been found.

As the next paper was short and purely descriptive, it was, at the author's suggestion, passed without being read. It was entitled

A Swiveling Joint for a 16-inch High-Pressure Main.

By R. E. Curtis.

This paper describes a joint, two of which were used as an expansion joint connecting the ends of two parallel 16-inch steam mains which, by reason of expansion and contraction, had a relative movement of several inches. On the end of each long pipe was placed an elbow looking upward, and above these two elbows were two elbows looking toward each other and connected by a pipe. The swiveling joints were in the vertical connections between the elbows. The elbows were permitted to swivel relatively to each other by being connected by a series of links attached to the flanges of each elbow, and then a pipe attached to one elbow turned in a stuffing box in the other. The pressure carried was 160 pounds, all details being designed for 225 pounds.

The next two papers on the program being by the same author, they were read in abstract and discussed together. The first of these papers was on

A Method of Determining the Temperature of Exhaust Gases.

By R. H. Fernald.

The exhaust gases here dealt with are those from gas engines in general. The paper shows the difficulty of the problem and discusses the conditions under which it may be possible to obtain results of any value. A method was sought for reducing the exhaust gases to atmospheric pressure without their losing any of the heat which belonged to them, and for this purpose a receiver was provided. After numerous experiments the apparatus which finally worked satisfactorily was a cylinder of fire-brick covered with a slab of the same material with a rubber band at the bottom to allow the gases to escape but prevent an inrush of cold air during the suction stroke. The branch exhaust pipe through which the gases were conveyed to this chamber had on its outer end a relief valve with a spring to be regulated for any desired valve. A thermometer inserted through the cover of the chamber would hold constant for constant conditions of running, but showed quick variations with changed conditions. A commercial substitute for the fire-brick cylinder was laid up of loose brick in double walls, the inner laid flatwise and the outer edgewise with a cover of planks and the joints stuffed with cotton waste. Several indicator cards are given showing different points of ignition, and accompanying these are tables of the resulting temperatures, showing how quickly the temperature indications followed the conditions. Referring to previous methods of measuring exhaust temperatures, the present apparatus seems to show that the results have been much too low, except those of Prof.

Robertson in a paper presented at a previous meeting.

The second paper was entitled

WORKING DETAILS OF A GAS ENGINE TEST.

By R. H. Fernald.

This paper gives a complete system for testing gas engines with the details of taking observations, making records and working up results, together with blank for the recording of data and the complete log of two tests made on gas engines at the laboratory of Columbia University. The process of working up these tests is shown in detail, with all equations, reproductions of the indicator diagrams and the results as worked out. Details are shown of the brake used, of the methods of measuring the air and gas supplied and of the indicator rigging. The system of testing is the most complete and detailed which has been published, and forms a valuable commentary on the Report of the Committee on Standard Methods of Engine Testing. The paper is much more than a record of tests which have been made, as it abounds with observations and cautions regarding points on which a beginner in such work is apt to go astray. The rope brake used in the tests is very simple and has features which are new to us.

In the discussion Mr. Supplee, referring to the first of the papers, stated that considerable experimenting had been done in Germany of late in order to determine the temperature of the exhaust gases, the method used being indirect through the measurement of the energy remaining in the gases. He promised to make a translation of the report of these tests in abstract and to add it to the paper.

The last paper of the session was on

LIQUID FUEL COMBUSTION.

By Chas. E. Lucke.

Of the different systems proposed for burning oil the paper notes three general classes. First is the burning of oil in an atmosphere without previous treatment by air or heat, as for instance when held by wicks or other porous material. In the second class are all oil fires capable of producing the "Bunsen effects," or where the oil is vaporized in such a way as to permit the mixture with it of a certain amount of air before it reaches the existing flame where it requires an oxygen atmosphere to support combustion. The third class includes all those methods in which the oil is vaporized and mixed with air in such proportions and in such manner that there results an explosive mixture of oil vapor and air. The vapor may be produced in retorts by boiling a mass of liquid, or by spraying oil on hot surfaces and then conducting it to a point where it may mix with air, or the oil may vaporize by contact with or approach to a hot surface in the presence of the air. An account is given of various methods that have been proposed and of a series of experiments at Columbia University to find a satisfactory burner. The burner which was finally successful was arranged to take its supply of air and oil through a Y-pipe and to discharge the mingled oil and air into a heap of rock fragments. The heated rocks act to vaporize the oil and to ignite the explosive mixture formed. The burner has been applied to the heating of a small boiler. The supply of oil and air is regulated by valves in the pipes which lead to the burner so as to furnish at all times the explosive mixture, and when this is done the mixture burns in the crevices of the rock heap without flame. If the supply of fuel is in excess, the superfluous oil vapor burns outside the rocks with a yellow flame. It is said in conclusion that this method deduced from the experimental researches will burn any oil with air at any pressure, provided only that enough air is supplied, and it is subject to an almost unlimited variation of form; it will deliver gases at a constant and maximum temperature, which may be lowered to anything desired by air dilution and is capable of burning more oil in less volume than any of the other forms tried, and this with the least possible amount of air.

Although the hour was getting late, this paper was received with a decided showing of interest. In the discussion, several speakers referred to the experiments reported in the paper in very complimentary terms. Mr. Frith thought that in a few cases the descriptions given in the paper were not entirely clear and hoped that the author would expand these before the paper went into the Transactions.

THURSDAY MORNING'S SESSION.

The session opened with the presentation of the paper entitled

A ROLLER EXTENSOMETER.

By Gus. C. Henning.

The mulitplying roller for indicating the elastic changes of length of material under test is among the earliest types of apparatus, and is still used for various purposes, but not with full satisfaction, on account of inherent errors, complication of design or difficulty in use. The new type of instrument described is intended to eliminate the hitherto objectionable features. Provision is made for application to all ordinary sizes and shapes of test pieces in tension or compression and in vertical or horizontal position. The proportions of diameter of roller and divisions on arcs or verniers correspond to ten-thousandths of inches, and the divisions on the arcs and verniers are exact minutes of arc, so that any good dividing engine can produce the scales. To determine the true change of axial length, the change of two elements of surface equidistant from the axis is measured. To do this a pair of rollers is provided, each mounted in adjustable bushings fixed relatively to each other and the attaching points. These bushings carry the graduated arcs, which are concentric with the rollers, on which are mounted the pointer-equipped with verniers to the arcs. The bushings and rollers are carried by a frame which is attached to the test-piece by spring-cushioned pointed screws. A similar frame carries adjustable distance pieces, and a pair of bars which are pressed against the surfaces of the rollers by springs; when the test-piece changes its length, bars bearing on the rollers cause the latter to revolve, giving largely multiplied readings of the change of length by the movement of the verniers over the arcs. The arms of the pointers and those of the arcs are made telescopic to allow of adjustment for inaccuracies in the diameters of the rollers. The lengths of these arms are adjusted by testing the indications of the instrument when moved by a micrometer screw. In order to allow of a positive reading, whether the instrument be used for measuring extension or compression, the arcs are made interchangeable. Actual reading can be taken only under fixed loads, but the approach of the yield point can be detected by watching the behavior of the verniers as the load is applied and noting the rapidity of their travel as the yield point is reached. This indication is more positive and reliable than that of drop of the beam of the testing machine.

The paper was presented and the instrument explained by the author, who, in answer to a question by the Chair, explained that it was intended to be removed after the elastic limit of the specimen had been passed and before rupture; a different instrument of the author's invention being designed to remain upon the specimen until after rupture takes place and to make a graphic record of the behavior of the piece under test up to the point of rupture.

MECHANICAL STOKERS FOR LOCOMOTIVES.

By Fred H. Colvin.

There has been a great increase in the size and fuel consumption of locomotives, while the fireman has not been enlarged, and devices to supplement or supersede his services are in demand. The stoker here described is that invented by John W. Kincaid. The stoker is attached to the furnace door opening, and while a mechanical it is not an automatic stoker. The mechanism of the stoker consists essentially of long conveying screws actuated by a steam piston through a ratchet movement, the delivery being regulated by throttling the steam supply to the cylinder. Three different strokes are given to the screws in regular succession; one stroke throws the coal to the front end of the firebox, the next supplies the middle portion, while the third does little more than to push its charge in over the deflector plate. The shape of the deflector plate determines the distribution crosswise of the fire. The stoker is claimed to largely get rid of the black smoke. It is admirably adapted to firing the Scotch boiler for marine service.

In discussion Harrison Emerson said

that Prof. Goss had some time previously presented before a railroad club some records of the performance of a locomotive which afterward seemed to be discredited by other records, but the discrepancy was explained by Prof. Goss on the ground that the second set of experiments had been conducted with the locomotives not working at maximum capacity and that it was becoming evident that the locomotive had now reached and surpassed the capacity of one man to get coal into the firebox fast enough to develop power up to the full capacity for which the locomotive is designed. Mr. Fowler stated that in connection with this point was one of the advantages of the mechanical stoker. Its work was done by power, the fireman merely directing that work, and with this stoker steam could be kept up under circumstances under which it would be impossible for it to be done by hand firing. He had witnessed the operation of the stoker and mentioned some little difficulty that was sometimes encountered in getting coal into the extreme back corners of the firebox, though this difficulty he considered not serious. Other great advantages of the machine he considered to be that the fire door was kept closed, preventing a blast of cold air against the tube sheet and that the firing was so even and under such well regulated conditions that combustion was practically smokeless.

Improved Indicator Cock for Engines.

By Albert K. Mansfield.

This paper gives a half-tone and drawings of a four-way indicator cock for engines. It differs from the familiar three-way cock so commonly used, in having a fourth connection to the steam chest or to the steam pipe near the throttle. The paper gives a number of indicator cards taken by the use of this instrument, which show the differences in pressure between the steam pipe and the cylinder during admission, and the text of the paper is mostly given to consideration of the conditions of highest efficiency as affected by the adequacy or inadequacy of the piping and ports. It shows that the "throttle" card, or the additional card taken with this cock, is an important witness to the need of more skill in devising the means of delivering the steam without undue loss of pressure.

J. E. Woodwell in a written discussion said he thought that engineers and engine builders should advocate and practice the making of contracts or tests of engines using the term "pressure at the throttle" rather than the term "boiler pressure." The diagrams in Mr. Mansfield's paper clearly show that there is often a material difference between the two. Mr. Barnaby stated that he had made a number of diagrams from the steam pipe just above the throttle and had noticed some peculiar phenomena. In some cases there seemed to be a vibration of the column of steam in the pipe, which was so synchronized with the motion of the engine as to cause a lower pressure at the beginning of one stroke than there had been at the beginning of the previous stroke, and he sketched a double engine diagram with such a steam pipe diagram as he referred to above it to show the relation and indicating that at the beginning of one stroke the pressure would be high owing to a forward impulse or vibration, would fall toward the middle of the stroke, rise again toward the end of the stroke and fall at the beginning of the succeeding stroke—the diagram being thus a three-looped one with initial pressure always lower at one end than the other. This phenomenon had been very puzzling at first, until he had suspected and ascertained its cause.

Electricity in Cotton Mills.

By W. B. Smith Whaley.

An account is given of the installation of an electric plant, having direct-connected alternating-current generators, transmitting power to induction motors which drive the line shafting for the machinery in various parts of the mill. The tests given are measurements to determine the loss between the indicated horse-power and that developed by the switch-board, and between that at the switch-board and the amount delivered to the work proper. A comparison is made of these losses with the same losses in a mill which took electric power from the street service and in one which had belt transmission throughout.

Attention is called to the fact that "the nature of the service—namely, the alternating current with induction motors—is quite different in its action from the direct current or similar conditions in a belt or rope-driven mill. The effect of acceleration is reduced practically to zero in this type of electric mill; there is a fixed ratio in the speed of the generators and motors which will not permit one part to accelerate in revolutions or retard over another; in electrical terms, this is caused by the fact that within the range of the torque of the machines, the step of the machines in phase with the system will not permit of any increase in speed without stopping any machines which get out of phase. The generators running in parallel are always in step and cannot change, consequently it is impossible to speed up or down one part of the plant over another due to variation of the work.

"The motors all run at the relative speeds compared to the generator for which they were designed, and any tendency to acceleration is checked and results in a diminution of the torque or displacement angle due to the flywheel effect of the armatures; within this range the entire tendency to vary the speed is absorbed. The accumulated energy causes an apparent reflex action of current, and the only effect which occurs is a reduction of the power absorbed by the system, which instantaneously adjusts itself between the motors and the generators, and reduces, as shown in the horse-power tables taken from the engines, the amount of power consumed in the cylinders, the speed at all times being practically constant. Under these conditions an absolutely steady speed is maintained, and the entire tendency to acceleration or retardation is absorbed in the machines themselves, insuring an absolutely uniform application of power at all times throughout the plant."

Prof. Benjamin, by request, referred to some tests of electric driving he had made some time previously in machine shops, and which had shown almost no advantage so far as efficiency or friction loss is concerned. He recognized, however, that the conditions under which his tests had been made were entirely different, and that, therefore, the fact that the results differed from those given in the paper did not controvert them. Mr. Dean criticised some of the figures given in the paper regarding the frictional loss in the engine and dynamo, and these figures were also questioned by Prof. Aldrich, who attributed the very low frictional loss recorded to the flywheel effect of the driven machinery, which he thought at times probably pumped power back into the dynamo, making of it a motor tending to drive the engine. Jesse M. Smith called attention to the fact that no statement was made in the paper as to whether the current was alternating or direct and said that with alternating current it was quite common for one motor to become a dynamo and to drive the other. Mr. Fowler called attention to the fact that in many other kinds of service, especially in railroad shops, the question of mechanical efficiency was not the important one in connection with the installation of electric driving, but that it was mainly a matter of substituting one central plant for a number of smaller, disconnected plants with their attendant expenses, and of convenience of location of machinery. In some cases, five to ten separate plants had been combined into one, to the manifest great advantage of the owners.

Opportunity was afforded also for the better arrangement of cranes and other means of handling machinery. On this point Mr. Supplee stated that according to S. M. Vauclain the introduction of electric drive at the Baldwin Locomotive Works had resulted in an economy of floor space amounting to 40 per cent. simply because the machinery could be placed to the best advantage without much regard to the means by which power was to be conveyed to it. In closing the discussion, the author showed that he was already familiar with the points that had been objected to in the paper and said that while he did not claim it in the paper, yet as a matter of fact he really did believe that under certain circumstances the frictional

loss of a dynamo decreased with increases of load; this because the dynamo floats, so to speak, and is not pulled to one side so strongly as is machinery driven by belts or any of the ordinary means.

Some Details of Direct Connected Generator Sets.

By William H. Bryan.

This paper describes the usual course of procedure by which the engine builder and the builder of the generator come to a mutual understanding as to the responsibilities of each and secure a combined result with a minimum of friction and delay. The important point to be determined between them is the shaft and bearings. The generator builder furnishes a dimensioned print which shows the limit lines beyond which the engine parts must not extend, the form for the shaft within the armature spider, the weights of the revolving parts and the unbalanced magnetic pull for 1-32 inch displacement. The latter particular is of great importance, as it affects journal areas and foundations and anchorage. The engine builder can then design his shaft and forward his drawings to the general contractor for approval. There is some room for discussion as to which party should make the actual fit and press the armature on, and the relative location of the two establishments often determines this. It is recommended by some to mount the armature on conical collars instead of the usual press fit. The question is considered also as to whether the shaft should be continuous or coupled by flanges or otherwise. The writer favors the continuous shaft, but finds a large and growing sentiment among builders of center crank engines in favor of the coupled form, the argument for this arrangement being formally stated. The paper questions the wisdom of the overload limit of 25 per cent.

In discussion W. D. Forbes thought the facts shown in the paper indicated that machine constructors cannot make holes as accurately as they can make shafts and his own practice had been, in fitting engine shafts to dynamos, to disregard the gages or to send them back to the owners as soon as received and simply to wait for the completion of the work to which the shaft is to be fitted. Referring to the matter of overload Mr. Forbes thought it would be proper to do away with the practice entirely and to sell an engine to develop a specific amount of power without providing for any overload. Prof. Sweet thought that the percentage of overload required was too great; that the first and most important requirement an engine builder had to meet was to supply an economical engine and very few engines, he believed, would work economically at 50 per cent. overload. Mr. Kent said that engines and boilers had been supplied since the beginning of the business with a capacity for overload, mentioned the case of a man who might want an engine to work, say ten hours a day, with a given load and then for two or three hours with an increased load, due perhaps to lighting, of say 25 per cent. He wanted to know why such a man should not be supplied with the engine required for his work and believed that he should be.

A Graphical Determination of Piston Acceleration.

By J. N. Le Conte.

This is a strictly mathematical paper. In the designing of steam engines it is often necessary to investigate the inertia effects of the reciprocating parts, and it is here shown how the labor of computation may be shortened by the introduction of graphical processes. These processes consist of geometrical constructions whereby the velocities and accelerations of the various points of the kinematic chain may be determined because proportional to the length of lines. A method is presented in the paper for finding the acceleration of the cross-head for any given angular position of the crank. The graphic solution of Rittershaus is referred to which gives the required quantity as the difference of two lines, the construction failing at the dead points. The method here shown finds the acceleration as the length of a single line, but it involves the use of the instantaneous center of the connecting rod with respect to the engine bed. The method is shown by three diagrams and accompanying demonstration.

In the absence of the author the paper was presented by the secretary and there was no discussion upon it.

Thursday Afternoon Session.

This was devoted to a steamboat and trolley excursion to the works of the Fore River Ship and Engine Company at Quincy, the members going directly from the hall to the steamer, on which luncheon was served by the local committee. It was rather a bleak day for an excursion by water (in fact, the coolest May 29 on record in Boston), but nevertheless it was evidently much enjoyed and the attendance was large, there being thirteen fully loaded trolley cars required for conveying the people from the boat landing to the works.

At present the works have on hand contracts to the value of about $9,000,000 and are employing about 1,500 men. First the forge department was inspected, in which there are eight steam hammers ranging from ¼ to 20 tons; steam being generated by the waste heat from the furnaces and the furnaces and the hammers served by two cranes, one of 50,000 pounds and the other of 150,000 pounds capacity. In the power house the most prominent feature was a large cross-compound, two-stage Rand air compressor of 5,000 cubic feet capacity. Other compressors are also in use, including an Ingersoll-Sergeant compressor of 1,000 cubic feet capacity, this large amount of air being required owing to the fact that air-driven tools are much used about the works. There is also an electrical distribution of power, practically all the machines in the machine shop and elsewhere being driven by individual motors. Some of the heaviest tools for the machine shop have not yet been installed these including a 108-inch crankshaft lathe. Some large lathes were at work on propeller shafts and a 12x20-foot planer was at work. Engines for the naval vessel "Des Moines" were being erected and also auxiliaries for the same vessel. Torpedo boats and other vessels were in course of construction for the navy, and among others is a seven-masted schooner, the length of which on the water line is 403 feet and it will have a capacity to carry about 8,000 tons of coal; steel masts are being made for this schooner which will weigh 17 tons each and with wood top-masts will rise 180 feet above the water line. Steam will be used for handling this vessel so far as possible so that a crew of only 18 men will be required. The battleships "New Jersey" and "Rhode Island" are under construction side by side; the overhead crane service having enabled 20 men to put in place two-thirds of the main framing of one of these vessels in 8 hours. There is a very fully equipped and large ship-tool shop and a commodious plate-yard served over its entire length by a crane of 150 feet span. A new fitting-out dock is being constructed and along this dock will be a Wellman-Seaver gantry crane capable of handling 75 tons 50 feet from the edge of the wharf.

Thursday evening was devoted to a reception given the society by the trustees of the Museum of Fine Arts, which, as previously mentioned, had been thrown open for such a purpose for the first time. It formed an ideal place for such a reception, which, as might be expected, was a very brilliant and largely attended affair; guests, beside the social pleasures of the occasion, having the privilege of inspecting the art treasures of the museum under very pleasant conditions.

Friday Morning Session.

This session was held in Pierce Hall of Harvard University. The first action taken was the appointment by the Chair of a nominating committee to name a committee for the revision of the constitution in accordance with the resolution passed Wednesday morning. The nominating committee was composed of Messrs. Swasey, Hawkins and Webber. Following this the first paper was taken up as follows:

A Technical Index and File.

By R. H. Soule.

The system here described is a combination of card index and file boxes, the cards approximately 3x5 inches and the file boxes of three different sizes: P, pamphlet, 7x10x3 inches; L, letter, 9½x12¾x3 inches, and G, gazette, 11½x16½x3 inches, the latter taking the pages of the larger technical journals. Printed matter to be preserved is cut up into single sheets

and all pertaining to a single entry are bound together by metallic binders and a file number is placed at the upper right-hand corner. These are numbered consecutively, there being a series of numbers beginning at 1 for sizes P, L and G. The classification is taken care of entirely by the card index. The general subject has its own line at the top and there are six, or at most seven, lines for entries. Sample cards are shown and a half-tone shows the cabinet for the filing cases, with a drawing also for the details of construction.

The discussion of this paper was quite animated. Mr. Quick considered larger cards than those recommended by the author to be advisable, and preferred classification of the clippings by subjects to serial numbering. He gave considerable advice to editors of technical papers which a very small amount of experience in an editorial chair would show him to be entirely impracticable. Mr. Voorhees suggested that manufacturers could advantageously supply much of their information on standard size cards suitable for filing. Mr. Supplee described the methods used in the index department of the *Engineering Magazine*. The clippings are folded to uniform size, numbered serially, and then done up in bundles of 100 each, the bundles being then placed on shelves in serial order. The index card gives the number of the clipping only. He pointed out that to file the clippings by subjects and then index them by the same method was really to make two indexes. Mr. Fowler enlarged upon the importance of having standard size catalogs. Such catalogs were carefully indexed by him, but others went into a convenient waste basket, and he knew of other engineers who followed the same plan. Mr. Lane called attention to the need of a provision in filing systems whereby the discarding of old clippings could be accompanied by the discarding of all index cards which referred to them. Mr. Oberlin Smith considered that to throw away a catalog because it was not of standard size was to bite off one's nose to spite one's face. In closing, Mr. Soule admitted the advantage of a larger card than the one given in the paper. He did not believe in filing by subjects, as that plan sacrificed all possibility of compactness, as surplus space must be provided for all subjects. He had had much to do with the early movement in favor of standard size catalogs, and considered that all had been done in that direction that could be done. We must get along without them.

The next paper taken up was

Steel and Concrete Coal Storage Plant.

By Franklin M. Bowman.

The coal storage plant of the Lowell Gas Light Company, Lowell, Mass., is here described. This is a modern and substantial and fully equipped plant with a capacity of 25,000 tons. It is a steel frame structure with concrete walls, foundations and floor, with a tile roof resting on steel purlins. The steel truss is braced from the outside of the building with the main columns vertical. The inclined back forming the brace at each column is outside of the storage and supports the overhang of the roof. The coal in this building is stored on the ground, and it is important that the inside of the storage be entirely lined with concrete so that no part of the steel work is exposed to the action of the coal. The danger of corrosion is largely accentuated in a coal storage with its sulphur and other corrosive constituents. In this building the steel work which is not covered by the concrete cannot be reached by the coal, which is piled to a depth of 40 feet. Special provision is made for handling the coal in case of spontaneous combustion, and pipes which pass through the center of the mass give means of always determining the temperature. The paper concludes with a description of the conveyor mechanism. The driver is located in the truss. Sprocket wheels are not used, the chain being driven by pawls. The machinery receives the coal from a hopper under the railroad tracks, cracks the lumps to a uniform size and carries them without transfer to any part of the building. The erection of the building was done very rapidly.

This paper was read in abstract by the Secretary, and it brought out no discussion. At this point Mr. Swasey, as chairman of the nominating committee, brought in the report of that committee, which named as the committee for revising the constitution, Messrs. Towne, C. W. Hunt and Jesse R. Smith. The next action was the taking up of a paper on

Repairing a Broken Cylinder.

By H. M. Lane.

The writer gives an account of the repairing of a broken horizontal blowing cylinder, 60x100 inches. A piece of the flange was broken out into the counterbore, but not going into the working part. A casting was made of a piece to replace the broken flange and also a large brass patch casting to go on outside and secured by numerous bolts. A band also was put around the cylinder back of the patch with long bolts passing through the patch to the cylinder head and taking the strain of it. Two years later a much more serious break occurred at the other end of the same cylinder and this also was repaired. In the first case a pattern for the patch was made by a patternmaker, requiring a week's work, while in the second case a casting was made by first modeling a clay patch over the cylinder and then taking a plaster cast of it, the pattern being thus produced in less than one day. The cylinder as repaired has been in use three years.

No remarks were offered in discussion of this paper, and the program was continued by the reading of

The Flying Shear.

By F. E. Edwards.

This paper tells of successive constructions, advancingly more difficult, of an ingenious and highly interesting type of machine. The first was for cutting off the ends of blooms up to 9 inches of cross-section as they emerged from the rolls and were in continuous motion, and in connection with this was another shear for cutting the running bar when rolled down to 1½ inches square into pieces of determinable lengths of from 20 to 30 feet. In the latter operation the speed of the bar was of course much greater than in the former. The general principle consists of providing the shear with trunnions upon which it can swing like an inverted pendulum, the shearing being done at the outer end, or at the part having the greatest velocity, the swinging being at such a speed as to coincide with the motion of the bar. After each cut the shear swings back to its initial position for the next cut, and so on continuously and automatically, each cycle being completed in less than one second. For high speed work, as in cutting off cotton ties, 11 feet 6 inches long, 150 a minute, an entirely different construction was employed. The knives were carried on conical drums geared together. To cut long lengths without having large drums they were only brought within the cutting distance at each second, third or fourth turn. By shifting the knives and by changing the gears any length desired could be accurately cut.

This paper elicited no discussion, and the next on the list was read in abstract by the secretary. It was entitled:

Cold Working Sheet Metals in Dies.

John D. Riggs.

The author first speaks of the great reductions in cost that have been brought about by the use of dies for blanking and drawing, and refers in general terms to some of the uses to which they are put.

Speaking of plain cups, he says: "The depth which may be drawn at one operation is commonly taken as about half the diameter for small cups, and one-fourth for larger ones; when more than this is required, two or more operations are resorted to. In drawing and reducing bright steel the writer has found it possible to draw to 9 inches diameter, anneal and reduce this to 6 inches diameter at once." Drawings of a number of different dies for various purposes are given.

For the diameter of a blank to be drawn to a cup the author gives some formulas in which

C = the outside diameter of the cup,
b = the width of the annular ring to be added to C for forming the sides of the cup,
h = the hight of the cup (outside measurement),
r = the radius of the rounded corner (outside),

(*Continued at page 822.*)

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe: Twenty-five shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *26,000 copies are printed. Total for 1902, so far, 432,250 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
Two Draw-Stroke Shapers	785
Catalog File	786
Forty-Two Inch Engine Lathe	787
Variable Speed Device	788
A Monkey-Wrench Story	788
Notes by a Wandering Mechanic	789
Action of a Wobbling Saw	790
Some Guns from China	791
A Lathe Attachment for Side Adjustment of the Cutting Tool	791
The Flat Drill as a Turning Tool	792
Friction Countershaft	794
Spring Coiling Machine	795
Echoes From the Oil Country	795
Letters from Practical Men: Special Oscillating Turning Device....Homes of Workmen in England....Gearing Up a Lead Screw and Driving by it for Steep Helical Pitches....Allowances for Press Fits....A Small, Cheap Jig....Micrometrical Forging	797-808
The Methods of Conducting a Shop Drawing Class	810
Boston Meeting of the American Society of Mechanical Engineers	810
Concerning the Selection of Matter for Publication in the AMERICAN MACHINIST and *Engineering News*	820
The Worcester Strike	821
Obituary	821
Some New Things	821
Commercial Review	823

Boston Meeting of the American Society of Mechanical Engineers.

The Boston meeting of the American Society of Mechanical Engineers will be regarded as one of the most successful in the history of the society. While there were no professional papers that could be called epoch-making, those presented were fully up to the society's standard and the discussion upon them was spirited and instructive.

In its social aspects the meeting was exceptionally enjoyable; the local committee under the leadership of F. H. Boyer and composed largely of men connected with the Massachusetts Institute of Technology having done all that generosity could suggest or indefatigable industry provide for the comfort and enjoyment of their guests.

While President Reynolds was of course missed, Mr. Dodge certainly proved a very admirable presiding officer, and upon every occasion reflected credit upon the society.

The most important action taken was that which related to the work of the Finance and Joint committees, which have been considering the general affairs of the society, and it was noticeable that every expression from a representative of the Council was in favor of the members giving free expression to their views regarding the society's affairs.

It is to be hoped that the committee appointed to write constitution, by-laws and rules for the society will receive many suggestions from members. Such suggestions are invited and may be sent to the Committee on Rules at the society's house. In the formulation of this work there will be opportunity for placing the society upon a basis much better suited to the members generally than it is at present and the opportunity should not be neglected; the letter ballot and the right of voting by proxy insuring that the will of the majority can prevail.

Concerning the Selection of Matter for Publication in the American Machinist and Engineering News.

We find in *Engineering News* of April 24 an editorial article or declaration of principles which so accurately fits our own practice and goes over ground so often traversed by us in correspondence that we are impelled to print the article of our contemporary. It shows that high-class technical journals in any field find practically the same difficulties in the selection of matter and must adopt practically the same rules of practice. By substituting AMERICAN MACHINIST for *Engineering News* the article fits our practice exactly and the underlying reasons for it are admirably stated. Our contemporary says:

Not a day passes but there come to this office letters which indicate a large misunderstanding on the part of the writers as to the policy of this journal respecting the selection of matter for publication. There is a great and amusing variety in these letters. Some offer to pay cash for the publication of an article. Others offer "trade write-ups," so-called, and ask that they be inserted in return for advertising patronage, present or prospective. Others who offer contributions appear to think that an introduction from a personal acquaintance of some member of the editorial staff is necessary, in order that their contributions shall receive attention.

So many of these evidences of misunderstanding as to the policy of this journal have come to us that we have thought it worth while to formulate the following general statement:

I.

The selection of all matter for publication in the reading matter pages of *Engineering News* is made solely on the basis of its interest and value to the readers. This journal has no "deadhead" list. Its subscribers pay five dollars a year for their paper and are entitled to receive the best matter that the editors can select. To make this selection on any other ground than the readers' interest—to publish this article to please a personal friend, that to please an advertising patron, the other for some form of payment, direct or indirect—is essentially to defraud the subscriber.

The article which is chosen for such ulterior reasons might be in itself comparatively harmless; it might be so well written that not one reader in a thousand would notice it to be below the standard usually maintained in this journal; yet if the principle is once established that articles may be selected for publication for other reasons than their actual value to the reader, the road downhill is an easy one. If one advertiser is given a "trade write-up," another must have a "reading notice." It is a short step from that to the direct sale of space in the reading matter pages as part of an advertising contract, and another short step to the publication of paid puffs to help one competitor and paid blackmailing articles to injure another.

This is the reason why our rule that the readers' interest, and that alone, must govern in the selection of articles is rigidly maintained.

II.

A very large part of the important and interesting engineering work of the present day is being done in connection with manufacturing establishments. The published description of this work may be and often is an exceedingly valuable advertisement for the parties interested. This fact, as stated above, is no reason why we should give space to it in *Engineering News;* but, on the other hand, it is no reason why we should exclude it. What we are after is what will interest our readers. If the publication of an article benefits somebody or other as an advertisement, so much the better.

The editors of *Engineering News,* there-

fore, receive and examine with great care matter submitted by manufacturers, advertisers and others descriptive of new devices, machinery, tools, plant and methods of doing work, and selection is made from this matter solely on the basis of what the editors believe to be the interest of the readers. Thus the "trade write-up" is judged on the same basis as the original contribution of a practicing engineer, or the paper read before an engineering society. The better the article which the manufacturer submits, the better its chances of acceptance. It must be remembered that the amount of matter offered to the editors, and from which they must make their choice is many times as great as the pages of *Engineering News* can contain. Obviously a great deal of matter has to be rejected, not because it is not good, but because it does not rank among the best.

III.

The conditions of publication are often of importance in determining the acceptance or rejection of an article. The "trade write-up" which is sent out broadcast to all sorts of trade journals is pretty sure of rejection. That which is sent out for simultaneous publication in a limited list of papers stands a little better chance, but if accepted it will generally be given briefer space than it would receive were we given the first opportunity of publication, or were the article given to us exclusively.

IV.

Not only for the sake of securing its acceptance, but for the sake of holding the interests of the largest number of our readers, it is worth while to take much pains in the preparation of matter to be offered to *Engineering News*. Where matter is to be submitted by a manufacturing establishment we would counsel its preparation by the engineering department rather than the advertising department. What we want, and what our readers want, is not "glittering generalities," but plain statements by the practical men of how engineering problems have been solved. For illustrations, we prefer drawings or blueprints and good photographs, from which we can prepare our own cuts.

V.

Final decision as to whether an article offered to us will be accepted cannot be made until the completed article is placed in our hands. We will give an opinion, however, on request, as to the probabilities of an article on a stated subject being acceptable. Matter found unavailable for use will be returned, if return is requested.

VI.

As a rule, new inventions, machines, etc., are not described until they have been actually built and practically operated. Exception to this rule is made only in case a device is of unusual interest and is of such a character that its merits can be fairly judged from the description and drawing. It may be added that this rule works to the benefit of the inventor. It is a mistake to rush into print with the description of a device until it has actually taken concrete form, and until actual experience can be quoted in support of the claims made for it.

VII.

We pay cash for original contributions to *Engineering News*. Articles prepared by our own staff on the basis of information furnished by manufacturers are of course not paid for, under ordinary circumstances. No articles are paid for unless furnished exclusively to us, and in the submission of matter by manufacturers it should be explicitly stated whether any prior publication has been made, and, if so, where (mention in trade catalogs should not be omitted). It should also be stated whether exclusive publication is offered to us or whether the matter is to be given to other journals, with full particulars.

VIII.

The editors lay no claim to infallibility of judgment or infinite knowledge. They may often err in their selection of matter by accepting the poorer and rejecting the better. Moreover, they have to be governed by conditions of which the outsider knows nothing. Available space and current interest in a particular line may often cause the acceptance of an article which is in other respects not so good as other articles which meet with refusal. The demands on the time of the editors are such that they cannot undertake to state in detail the reasons which govern their decision to accept or reject any article.

The Worcester Strike.

There is but little change in the strike situation in Worcester. A continuation of the tactics employed last week to force the strike to an issue in other shops by taking in obnoxious work has resulted in 22 men leaving P. Blaisdell & Co., 10 men from H. G. Barr & Co. and a part of the force of L. Robbins. In the vicinity of the proscribed shops many "pickets" are in evidence, pursuing the usual tactics familiar to the reader of strike literature. As yet little has transpired to indicate the outcome of the matter.

Obituary.

Nathan Babcock died at Pawcatuck, Conn., May 31, seventy-eight years old. Mr. Babcock was born at Westerly, R. I., and at the age of 18 he became a machinist apprentice at Warwick, R. I., and followed the trade until 1855, when he went into partnership with C. B. Cottrell for the manufacture of cotton and woolen machinery, and a few years later the firm began building power printing presses. Mr. Babcock retired from the firm in 1880 and two years later he organized the Babcock Printing Press Manufacturing Company, of which he was secretary and treasurer until his death.

Some New Things.

A NEW HAND BLOWER.

In the accompanying illustration is shown a new hand blower placed on the market by the Buffalo Forge Company, of Buffalo, N. Y. The design is neat and embodies some excellent points. The legs are of heavy steel tubing firmly fastened to the rigid cast-iron standard which supports and is fastened to the blower in such manner as to allow ready adjustment. The

A SMALL PORTABLE HAND BLOWER.

mouth of the blower may be turned to any desired angle of discharge. The blower has a perfectly balanced blast wheel and a train of enclosed cut spur gears speed the blast wheel up in the proper ratio. Thorough means are provided for oiling all bearing surfaces, small brass oil tubes leading to all such points. All the parts are detachable and interchangeable, and may be packed into a very small space for transportation.

Scale formed by the use of hard water in gas-engine cylinder jackets can be effectually removed by filling the jacket with commercial muriatic acid, according to Mr. C. W. Andrews, at a recent meeting in Columbus of the Ohio Gas Light Association. It is allowed to stand in the jacket until the decomposition of the scale, with the attendant evolution of carbonic acid gas, is completed. One application has generally been found sufficient if the scale is light.—*The Engineer.*

In the new copyright law of Siam it is provided that all books which have been printed contrary to the provisions of the law shall belong to the person holding the copyright. What a beautiful provision this would be to incorporate in a patent law.

Boston Meeting of the American Society of Mechanical Engineers.

(*Continued from page 819.*)

s = the stretch or elongation of the metal in the edge or sides p.

$$\pi Cd = \pi (C + b) b = \pi Cb + \pi b^2$$

Reducing and allowing for stretch

$$p = b + \frac{b^2}{C} + s$$

And as the corner is always more or less rounded, we may say:

$$p = b + \frac{b^2}{C} + s + \frac{r}{2}$$

The diameter of the blank is represented by

$$C + 2b.$$

s varies from 0 to 5 per cent. of p in tin plate or steel.

The discussion was opened by Oberlin Smith, who considered the paper very interesting but very fragmentary, as the subject would require a volume for its adequate treatment. His experience had shown that, with ordinary commercial material, cup-shaped work could be drawn materially deeper than the author's formula would indicate. The thickness of the sheets was an important factor in the possible depth. Thin metal is much more apt to wrinkle than thick, and with the former double action presses must often be used where they are unnecessary with the latter. He gave instances in which the speeds mentioned in the paper had been very greatly exceeded. In estimating the output of presses, his practice was to consider the day as composed of 500 minutes instead of 600—that is, he multiplied the number of strokes per minute by 500 for the daily output. The figures thus obtained are apt to be a little low, but he considered the rule a safe, conservative one. Coining press work was not mentioned in the paper. The speeds possible in this class of work depend upon the depth of the relief, as the metal requires a certain amount of time to flow into the pattern of the die. He gave one case in which small work in thin sheet metal had been made at a rate of 400 strokes per minute, and referred to the great development of press work in punching armature disks for dynamos. For the larger sizes of disks which are punched complete at a single operation, a single set of dies might cost as much as $2,000. He referred to a notching press for this class of work, which had been especially designed for high speed. The speed originally intended was 250 strokes per minute, but this had been successfully increased to 360, and 400 would be entirely feasible, except for the fact that, such speeds not being contemplated in the design, the press had not been balanced and at such a speed the vibrations due to the lack of balance were such as to prevent its use. Mr. Hawkins referred to a patent bottle cork, in which a thin sheet metal cap is used, which, by the use of gang punches, are made at the rate of 840 per minute, or about half a million a day. To this Mr. Smith replied by referring to a case of work with gang punches in which the output exceeded a million a day, and another speaker mentioned a similar case in which 2,080 blanks were punched each minute.

Mr. Stetson referred to the inventor of a pin-making machine, who found his labors stopped by the fact that he could buy pins at the same price as pin wire, and other speakers spoke of factories in the Naugatuck Valley where finished work could be bought as cheaply as the stock from which it was made.

The next paper, which was read in abstract by the secretary, was entitled

PROPOSED STANDARD FOR MACHINE SCREW THREAD SIZES.

By Chas. C. Tyler.

Attention is called to the variation in the size of machine screw threads as made by different manufacturers and to the inconvenience resulting where screws are used in large quantities. The Brown & Sharpe standard gage is given having a zero at 0.05784 inch and a constant difference between numbers of 0.01316 inch. In place of this is proposed a standard having an angle of 60 degrees and a flat at the top of the thread equal to one-eighth of the pitch; or, in other words, a thread of the same form as the United States standard or Sellers thread.

For a screw gage the writer suggests a series beginning with 0.05 inch and increasing by 0.01 inch up to 0.11. From this the increase is 0.015 up to 0.180 inch. Above that the diameters run 0.2, 0.22, 0.25. Above this, up to ½ inch the variation is by 1-32 inch. For the pitch of the thread a value is proposed about the same as is standard on the present screws of approximately the same diameter; where any variation is made it is towards a finer pitch. The equation for the pitch is

$$P = 0.23 \sqrt{d. + 0.625} - 0.175.$$

This is the same formula as that proposed by George M. Bond in 1882, and differs from the one used for United States standard bolts only in the coefficient, which is 0.23 instead of 0.24. A table is given showing the variation of the pitch adopted from that given by the equation; this difference is in all cases very small.

The author refers to the familiar fact that a thread should bear upon its sides rather than upon the top, and to secure this he proposes that the taps should have threads truncated only one-sixteenth of the pitch at the top instead of one-eighth, while the dies used in threading the screws should truncate the screw threads one-sixteenth of the pitch at the bottom instead of one-eighth, thus giving a clearance at both top and bottom of the difference between one-sixteenth and one-eighth of the pitch. Specifications are given for standard taps and gages, both for reference and for common shop use. The important measurement of a screw thread is considered to be the diameter in the angle of the thread, and in order to compare the working gages with the standards it is proposed to use a device which has been developed in the different watch factories, and another which has been designed in the small tool department of the Pratt & Whitney Company. These devices are for comparing two threads, and by their means the author proposes that the working gages shall be compared with the master gages and the sizes accurately maintained.

The secretary also read a letter from Mr. Tyler, in which he regretted his absence and suggested the appointment of a committee to standardize machine screws. Mr. Bond spoke of the necessity for determining sizes by the sides of the threads and giving clearance at the top and bottom. He commended the paper. Mr. Oberlin Smith considered that the bolt should be larger than the tap by a standard amount, and that in the sizes wherein bolt and machine screws overlap—namely, between ¼ and ½ inch—the threads should be the same. Even though the threads of the smaller sizes of Sellers standard bolts are too coarse, as they probably are, it is better to use them than to have two standards. Mr. Swasey considered the matter to be one of a great deal of importance and moved that the appointing of a committee of five to draw up a standard system of machine screw threads be referred to the council with power. The motion was carried. Mr. Stetson referred to the difficulty of maintaining the correct pitch with die cut threads, especially after the dies had become somewhat dull. Mr. Wilfred Lewis explained that the difficulty with the formula for the pitch of the Sellers thread arose from the fact that with zero diameter it did not give zero pitch. He gave upon the blackboard a formula which corrected this defect and which also agreed with the Sellers scale.*

This completed the program, and after the usual formal resolutions of thanks to those who had been instrumental in making it the pronounced success which it was, the meeting adjourned to a luncheon provided by the authorities of Harvard University, which was served in the magnificent Memorial Hall of the University. After the luncheon the convention was briefly addressed by President Eliot of the University, and to the address Vice-President Dodge made a brief and happy reply. The afternoon was passed by inspecting the buildings and grounds of the University. In attendance the meeting was a record breaker, the register recording over 850 names.

*Printed copies of any of the papers may be had for a small sum by addressing the Secretary of the Society at 12 West 31st Street, New York.

Commercial Review.

NEW YORK, Monday, June 2.

Two lines of manufacture which have been very active this spring, as explained by a man prominent in the affairs of an old-established supply and machinery house, and which have indirectly contributed a very substantial amount to swell the total of his trade, are automobile construction and small marine gasoline motor manufacture. The latter line, we are told, is enjoying a great boom this year. Pretty much everyone, it would seem from the account, is putting a gasoline motor into his boat. Owners of rowboats, sixteen-foot sail boats, fishing boats, sloops of 50 or 100 tons, in Jamaica Bay, in Staten Island waters, down on the Jersey coast and everywhere else are being struck by the fad to introduce this convenient source of power. One may now behold a sail boat with all sails set scudding along in a dead calm and tacking neither to port nor starboard in order to make her way. The introduction of the new system is stimulated by the fact that under some conditions in which a license would be required to run a steam engine, a man may blow himself up by a gasoline motor without breaking any of the laws. What with all the seaboard and the lake shores the opportunities for this line of trade are vast, and we understand that there are in the country some hundred or more builders of such motors. They are scattered everywhere, three for instance being in Perth Amboy, N. J.

One of the principal power-transmitting machinery companies having an office in New York is seriously considering an advance of the prices on its iron goods.

Liberty street, New York, has long been recognized as the local home of trade in machine tools and in other branches of machinery, although the domicile extends also across the two streets immediately north—Cortlandt and Dey. The aspect of Liberty street, as visitors to the city have no doubt noticed, has been undergoing a change in the last few years, many of the old-fashioned structures being replaced by modern office buildings only less imposing than those of the financial district. The enlarged office space thus afforded allows a better concentration of the numerous concerns than would otherwise be possible and a cheerful office packed away in one of the new structures is considered quite the proper thing instead of the dingy ground-story stores of days gone by. This year's installment to the transformation of the thoroughfare has been the completion of the Engineering Building, situated at No. 114-118 Liberty street, and which has been tenantable since May 1, although some work is still being done on the inside. As its name invites, various mechanical concerns have moved into it. The ground-floor rooms, which are among the best on the street, have been taken by the International Steam Pump Company, the Knowles and Blake, as well as the Worthington and other departments having taken up their abode in the building.

The Q. & C. Company, manufacturer of railway specialties, will operate in its own name, commencing June 1, principal offices in the Western Union Building, Chicago; New York office in the Engineering Building, 114 Liberty street, with the general sales department located at the shops, Chicago Heights, Ill. The company is receiving a good inquiry for its manufactures, the demand being both domestic and foreign. While the foreign inquiry is hardly as good as last year the domestic is better and the outlook for trade is regarded as very favorable, barring some special catastrophe to the business world. The company has not found it necessary to make material advances in prices.

Dey street, New York, more particularly the block just west of Church street, has long been a district for mill and contractors' supplies, power transmitting and conveying machinery. Its character as a power transmitting machinery center is becoming more pronounced than ever. One of the latest concerns to locate its New York store there—at No. 44—is the Oneida Steel Pulley Company, whose local business is still in charge of A. Van Vechten & Co. The company has for a few weeks had on the market its new pulley with pressed-steel center and wood rim. The Pennsylvania Steel Company has ordered upward of fifty of them, ten of these being of 48 inches diameter and 12 inches face. The company will have an all-steel pulley made in two or three months. A line of regular wood pulleys is also carried.

The Owen Machine Tool Company, Springfield, Ohio, whose plant was destroyed by fire, February 10, is located in temporary quarters, preparing new jigs and tools for the manufacture of the Owen milling machine. The capital stock of the company has been increased to $100,000 and they are now preparing plans for their new plant, which will be 75x250 feet. The shop will be of modern construction, equipped with the best machinery that can be purchased for the manufacture of milling machines.

The Miller Improved Gas Engine Company, of Springfield, Ohio, is building a new shop which it will occupy in a few weeks. The Foos Gas Engine Company, of the same place, shipped three carloads of gas engines the other day. During the last few weeks the company has had all it could do to fill orders. It business is gradually increasing and extending to new territory. The O. S. Kelly Road Roller Company, also of Springfield, has purchased an old steel plant and rolling mill which will be thoroughly remodeled and equipped with modern facilities for making road rollers and traction engines.

A factor which may prove of considerable importance in the pump line is Fairbanks, Morse & Co., of Beloit, Wis. The firm is going to launch out into the manufacture of steam pumps of all sizes and is erecting a number of new buildings, including a 300x90-foot shop, and a 132x92-foot room to be equipped with molding machines. To the 1,200 men now employed at the works some 500 more may eventually be added.

A wood pulley house having considerable dealings with the nearby South, among houses which sell to the cotton mills, etc., finds a good tone prevailing in that region. There is quite a spurt of inquiry from North Carolina.

During the past month the Niles-Bement-Pond Company has ordered of the Crocker-Wheeler Company fifty or more crane motors, outputs ranging from 1½ to 50 horse-power.

Pawling & Harnischfeger, Milwaukee, Wis., makers of electric cranes and hoists, write us that the condition of business remains unchanged and is entirely satisfactory. They send us a long partial list of orders recently booked. We note that a few of the concerns which have been buying cranes are: Fairbanks, Morse & Co., Warren City (O.) Boiler Works, Kutztown Foundry & Machine Company, Chapman Valve Manufacturing Company, Warren (Mass.) Steam Pump Company, Lodge & Shipley Machine Tool Company, Baldwin Locomotive Works, Gardner Governor Company, The Stilwell-Bierce & Smith-Vaile Company.

The Boston & Montana Consolidated Copper & Silver Mining Company, which is making additions to the electrical equipment of its smelters and refineries at Great Falls, Mont., has recently purchased eleven 15 horse-power and three 40 horse-power Westinghouse, 500-volt, shunt wound, direct-current motors. The mining company, having used a number of motors of the same make in extreme dirt and sulphur dust, where it is difficult to keep motors from burning out, is said to be pleased with the results, particularly that the insulation between the commutator bars is sufficient to prevent bad grounds.

The Webster Manufacturing Company has closed a contract to furnish a power-transmission, elevating and conveying machinery equipment for an ore sorting plant at the concentrating works of the Joseph Wharton iron company, Hibernia, N. J.

THE PRESENT STATE OF THE GERMAN MACHINE TOOL INDUSTRY.

The following is a free translation of an article which has appeared in more than one of the German trade papers and which bears the ear marks of the Tool Builders' Association or some of its partisans:

"According to a statement of the German Machine Tool Builders' Association to its members, which has obtained currency in the Empire, the imports of machine tools, which in 1901 had fallen from 6,429 metric tons to 1,702, have in the first quarter of 1902 further sunken to 228 tons, against 557 for the corresponding period of 1901 and 2,032 for the same of 1900.

Exports in this line have also decreased in the past year, viz., from 9,267 to 8,286 tons, which shows, however, by no means the same shrinkage as do the imports, and there has been an improvement in the first quarter of 1902—that is, 2,408 tons, as against 2,090 for the same period of 1901 and 2,204 for that of 1900. The imports from the United States, which have composed by far the largest item in the total machine-tool imports, were 1,166 tons for the year 1901, against 4,757 for 1900. In the first quarter of 1902 they were 107 tons, against 399 for the like part of 1901 and 1,501 for that of 1900.

"From the foregoing it may be perceived that the German machine-tool industry, in spite of bad times, has powerfully developed, in that not only has it gained a better control of the domestic market, till it now reigns there almost alone—and this in view of the once so important American trade, which it has reduced to a minimum—but also in that it is carrying on an export business energetically and successfully. While the manufacturers' profits on goods sent abroad may at present be small, it is of general popular economic value and of especial advantage to the line of trade, that the manufactories be kept as far as possible employed, and the industrial organism preserved in an elastic state. The machine-tool imports, which last year were little more than a quarter of those of the year before, appear at present ready to sink to an insignificant amount. For the first quarter of this year they were hardly a tenth of the German exports in this line, while for that part of 1901 the proportion of imports to exports was one-fourth and in the first three months of 1900 they were nearly equal.

"From this presentation of the market for German machine tools the conclusion might perhaps be drawn that in its tariff-political aspect the industry does not need the desired strong protection against foreign competition. This, however, would be a misdirected shot. For, without prejudice to the present great productive capacity and equal rank of the German machine-tool industry, it would have difficulty in meeting the American competition, if mechanical industries in the United States were not so active as to keep them amply well remunerated in the home market. There is to be noticed in America the same appearance as with us in Germany at one time, a marked neglect of foreign trade owing to the attractive business conditions at home. When the leaves in America turn, which must occur sooner or later, a strong attack will be made by the American machine-tool industry upon the German market and a materially higher tariff will be imperatively necessary.

"An example for home politics on the tariff question is to be found in the United States themselves. They exact to-day a duty of 45 per cent. ad valorem on machine tools, as compared with a rate of 3 to 5 per cent. in Germany, although, for many years, their exports of such machines have been known to be in great preponderance to their imports. To-day German machines would be entirely able to compete in America were they subject there only to a moderate duty of some 10 per cent. But the 45 per cent. rate naturally excludes them. The application of this example to Germany everyone may judge for himself.

"It may be remarked in passing that the Rhenish-Westphalian Industrial Exposition in Düsseldorf, through its truly brilliant and imposing exhibition of machine tools, affords everyone an opportunity to illustrate the high productivity of this line of trade. Never before has there been such an opening to the display of the German machine-tool industry with its noteworthy products in such completeness and variety."

CHICAGO MACHINERY MARKET.

The Chicago Edison Company has purchased an 8,000 horse-power steam turbine for installation in a large new plant that will be erected in this city. The delivery promised is next December. It is said that Charles T. Yerkes has bought a number of 8,000 horse-power turbines for his underground London railway system, but none have yet been delivered, nor have any in this country been put into practical operation in anything approximating in size this turbine. Considerable more progress is said to have been made in Europe in the matter of steam turbines than in America. Consequently the operation of this new venture of the Chicago Edison will be watched with considerable interest by power people. It is said that if the present purchase proves entirely satisfactory, two additional turbines of equal size will be purchased.

The representative of an automatic engine builder says that the lull which appeared in the Western demand a month or so ago has departed, being replaced by normal inquiry. His acquaintance and that of others with this above-mentioned lull was not shared by all sellers of power in the West, for with many of them inquiry has been almost uniformly good from the beginning of the year. However, in various lines of trade associated with power, trade a few weeks ago showed some contraction as compared with its previous volume. The demand for fall installation of power is not due until about July, so that the present business runs largely to the earliest possible deliveries that can be arranged, and those makers who can furnish the earliest shipments receive the orders.

It is said that there are now in the market inquiries for $1,000,000 worth of blowing engines. Last fall makers of this type of machinery were beginning to catch up with their orders after a brisk run of business for two years; but this spring they are buried beneath the inquiries. The insatiable inquiry for steel has created a fresh demand for blowers. The representative of one large engine builder says that fully half their output is now going into electric railway work. But the big engines are not absorbing the entire capacity of the shops. The largest maker in the West has capacity well engaged up to next September for engines ranging from 100 to 300 horse-power.

Among recent orders taken by the Allis-Chalmers Company is a 5,000 horse-power engine for the Twin City Transit Company, Minneapolis, Minn.

Building capacity continues to increase. The Ball Engine Company, of Erie, Pa., has contracts for the erection of a large new shop immediately west of that city, work to be completed in about a year. Generally speaking, the outlook for the engine and boiler trade in the West is very satisfactory. Inquiries are numerous. Considerable business is essentially delayed because of the impossibility of completing structures. Bids have been received by the Lake Shore and Rock Island roads for one 800 and two 400 horse-power engines for their new passenger station at Chicago.

Quotations.

NEW YORK, Monday, June 2.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$21 15	@ $21 65
No. 2 X	20 65	@ 21 15
No. 2 plain	20 15	@ 20 65
Gray forge	19 65	@ 20 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	20 25	@ 21 25
No. 2 foundry, or soft	19 75	@ 20 75
No. 3 foundry	19 25	@ 20 25
Foundry forge, or No. 4	18 25	@ 19 25

The prices above quoted on pig iron are rather uncertain.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93 @ 2.03c. in carload lots. Smaller quantities from store, 2.10 @ 2.25c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Copper—Lake ingot, 12½ @ 12⅝c.; electrolytic, 12¼ @ 12½c.; casting, 12¼ @ 12⅜c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 30c.

Pig Lead—4.12½c. in 50-ton lots.

Spelter—New York delivery, 4¾ @ 4⅞c.

Antimony—Cookson's, 10 @ 10¼c.; Hallett's, 8¼c.; U. S., 8 @ 8¼c.; various brands, 8c.

Lard Oil—Prime City, 80 @ 82c. in wholesale quantities.

New Catalogs.

Philadelphia Bourse. Eleventh Annual Report. 6x9¼, pp. 16, paper.

J. Geo. Leyner, Denver, Col. Air compressors, 7x9, pp. 24, paper.

Purdue University, Lafayette, Ind. Annual catalog. 5x7½, pp. 245, paper.

Oliver Typewriter Company, Chicago, Ill. Typewriters. 7x9, pp. 24, paper.

Hoefer Manufacturing Company, Freeport, Ill. Machinery. 6x9, pp. 48, paper.

Charter Gas Engine Company, Sterling, Ill. Miniature Gasoline engines. Folder.

Bement, Miles & Co., Philadelphia, Pa. Steam hammers. 6x9, pp. 75, paper.

Fidelity & Casualty Company, New York. Flywheel insurance. 3½x6, pp. 24, paper.

Jeffrey Manufacturing Company, Columbus, Ohio. Belt conveyors. 6x9, pp. 32, paper.

Cincinnati (Ohio) Punch & Shear Company. Metal Working Machinery. 6x9, pp. 48, paper.

Railroad Supply Company, Chicago and New York. "Perfection" oil purifier. 6x9, pamphlet.

Buffalo Forge Company, Buffalo, N. Y. Buffalo improved ventilator. 3½x6½, pp. 14, paper.

Rumsey & Co., Seneca Falls, N. Y. Hydraulic and pumping machinery. 6x9, pp. 256, cloth.

New Process Raw Hide Company, Syracuse, N. Y. Noiseless pinions, metal gears. 3¼x6, pp. 78, paper.

Chicago (Ill.) House Wrecking Company. Machinery, supplies and merchandise. 6x9, pp. 238, paper.

Worcester Polytechnic Institute, Worcester, Mass. Thirty-second annual catalog. 6x9, pp. 197, paper.

American Steel & Wire Company, Chicago, New York, San Francisco. Rail bonds. 7¾x5¼, pp. 81, paper.

Bickford Drill & Tool Company, Cincinnati, Ohio. "56 Points of Vantage," 1902 edition. 4x6, pp. 46, paper.

Medart Patent Pulley Company, St. Louis, Mo. Pulleys, shafting, gearing, etc. 5¼x7¾, pp. 172, paper.

Hardy Motor Works, Port Huron, Mich. 1¼ and 4 H.-P. gasoline and gas engines. 3½x6, pp. 16, paper.

Armstrong Bros. Tool Co., Chicago, Ill. Tool-holders and machine shop specialties. 3½x6, pp. 40, paper.

Manufacturers.

The Anchor Duck (Cotton) Mills, Rome, Ga., will be enlarged.

The Sun Match Company, Philadelphia, Pa., will build a two-story factory addition, 40x40 feet.

One of the brass foundry buildings of P. & F. Corbin, New Britain, Conn., has been burned.

The capital of the Roanoak (Va.) Cotton Mill is being increased and the capacity will be enlarged.

H. W. Hubbard, machinist, Keene, N. H., has broken ground for his new shop. It will be 50x75 feet, two stories.

Chas. E. Ring, iron and steel, 423 Kent avenue, Brooklyn, N. Y., has bought land for a new building.

A new car repair and machine shop is to be built by the Utica (N. Y.) & Mohawk Valley Railway Company.

The Greystone Manufacturing Company, manufacturer of metal novelties, Greystone, Conn., is building an addition.

Plans have been completed for a manufacturing building, 110x225 feet, for the Art Stove Company, Detroit, Mich.

The La Crosse Threshing Machine Company, evidently a new concern, intends to build a factory at La Crosse, Wis., at once.

The Keystone Drop Forge Company, Chester, Pa., is about to erect a two-story machine shop and an engine and boiler house.

Ground has been broken at South Milwaukee, Wis., for the plant which the Kelly Thresher Manufacturing Company is to erect.

Fire has completely destroyed the plant of the Enterprise Stove Company, Vincennes, Ind. The plant, it is thought, will be rebuilt.

The Hunter Arms Company, manufacturer of shotguns, Fulton, N. Y., is making preparations for the addition of another story to the works.

McCormick Harvesting Machine Company, Chicago, Ill., has taken out a building permit for a two-story brick shop; estimated cost, $40,000.

The General Electric Company will shortly erect at Harrison, N. J., a three-story, 150x62-foot building for the manufacture of lamp filaments.

The Northern Pacific is planning for car shops at Missoula, Mont., which will comprise a 100x250-foot building with a 70x100-foot annex.

Architects J. H. Daverman & Son, Grand Rapids, Mich., have plans for a three-story factory for the American Mold Company, to cost $10 000.

The New Hamburg Manufacturing Company, Ltd., manufacturer of agricultural implements, Stratford, Ont., is preparing to rebuild its works.

The Wolverne Brass Works, manufacturers of plumbers' supplies, Grand Rapids, Mich., have been having plans prepared for a two-story foundry building.

The Susquehanna Casting Company has started the erection at Wrightsville, Pa., of a building, 230x60 feet, part of which will be used as a molding room.

The William Highton & Sons Company, manufacturer of hot air registers, Nashua, N. H., has commenced to build an addition of about 50 feet to its foundry.

A company to be known as the Caldwell Mining Car Manufacturing Company, capitalization probably $100,000, is about beginning to build a plant at Caldwell, O.

The Boston & Maine Railroad is to increase the capacity of its plant at Concord, N. H., and plans have been drawn for a 100-foot extension to the locomotive shop.

The new M. J. Johnson Company, of Madison, Wis., will manufacture a gasoline engine. The building was to be completed by June 1. About thirty men will be employed.

An addition will be built to the plant of Shelp & Vandegrift, manufacturers of cigar boxes, Philadelphia, Pa. It will include three additional stories and a boiler-house.

The Patton Paint Company, Milwaukee, Wis., has purchased a block of five acres on the Passaic River near Newark, N. J., on which a paint factory will be erected shortly.

E. J. Miller, collector of customs, and W. A. Ross, of 431 East Town street, Columbus, O., are behind a project for the establishment of a plant to manufacture mica electrical appliances.

There is a possibility of a new shipbuilding plant at Buffalo or elsewhere on the lower lakes. Capt. James Davidson, Bay City, Mich., is mentioned in connection with the enterprise.

A new plant, six stories, 48x175 feet, will be built at Allegheny and Glenwood avenues, Philadelphia, Pa., for the Rawson Manufacturing Company, manufacturer of patent step ladders, chairs and spring beds.

The Gadsden furnace of the Alabama Consolidated Coal & Iron Company, of Birmingham, will be enlarged and repaired. It has been decided to increase the capacity of the plant from 165 to 200 tons of pig iron daily.

It is expected that the power-house of the Moline, East Moline & Watertown Railway will be located at East Moline, Ill. At present the company will probably make temporary arrangements for a supply of power.

The Dennison Manufacturing Company, Boston, Mass., has awarded the contract for the construction of a new brick building at its plant at South Framingham, Mass. The structure will be 400x50 feet, four stories and basement.

The Monadnock Mills, makers of a fine grade of book paper, at Bennington, N. H., have broken ground for a new addition to their plant, the estimated cost of which is $200,000. New and more modern machinery will be installed throughout.

The Meaford Manufacturing Company, Meaford, Ont., has begun work on a building to be 200x60 feet, four stories. The company expects this building, dry kiln and power-house to be completed by August 1, and the work of manufacturing furniture to commence about October 15.

The American Tube & Stamping Company, Bridgeport, Conn., has purchased most of the machinery, as well as a site in Bridgeport, for a new plant, though up to a few days ago at least it had not been fully decided that another location would not be chosen, notwithstanding. It is expected to employ over 2,000 men.

The Automatic Machine Company, Greenfield, Mass., expects to erect a new factory this summer and increase its force of men. The capital has recently been increased from $15,000 to $30,000 and changes made in the board of officers. C. H. Ball is president; J. W. Smead, treasurer, and F. E. Wells, F. O. Wells, F. E. Snow, J. W. Smead and C. H. Ball, directors.

The Baltimore (Md.) Copper Smelting & Rolling Company has purchased three blocks of ground adjoining its plant, with a view to concentration of the work and for more effectual and economical operation, as well as for extension of facilities for new business offering. Plans have been made to erect eight or ten new furnaces and appliances and additional buildings.

The Invincible Grain Cleaner Company and the Huntley Manufacturing Company, manufacturers of grain-cleaning and buck-wheat machinery both of Silver Creek, N. Y., are building additions. The Invincible Company is installing a new power plant of increased capacity. Silver Creek manufactories in general are employing larger forces than ever before in their history.

William Shawd (who, we presume, is connected with the Shawd Machine Works, Springfield, O.) and H. Brydon were recently in Urbana, O., upon invitation of the Commercial Club of that place, in regard to the organization of a company with a capital stock of $50,000 to manufacture a gas engine which has been patented by Mr. Shawd. It is proposed to build a factory at Urbana.

Plans have been drawn for a 220x45-foot four-story addition to the plant of Smith & Wesson, pistol manufacturers, Springfield, Mass. A large additional force of machinists would be employed in the new building, the construction of which, as planned, depends upon whether Mr. Wesson shall secure

from the city the franchise for running wires for power and lighting from the proposed Barrett's Junction power plant.

The Baldwin Locomotive Works are about to build a foundry, 397x80 feet, on Buttonwood street, from Fifteenth to Sixteenth street, Philadelphia, Pa. Arrangements are being made for a traveling crane between each "square" from Broad street to Nineteenth. In view of all the improvements the company has lately made and is making, it is improbable that this big industry, which includes a colony of 20,000 persons, will depart from Philadelphia, as it was thought some time ago might be the intention.

The Yale & Towne Manufacturing Company, 9 Murray street, New York, has just completed extensive additions to its main plant at Stamford, Conn., to provide for the growth of its business and for the accommodation of that part of it heretofore conducted at Branford. It expects to accomplish the transfer during June, and is offering the Branford plant for sale. This Branford plant comprises about six acres of land and a group of buildings containing some 90,000 square feet of floor area, with power and electric lighting equipment. It has accommodated upwards of 600 employees.

The American Machine & Ordnance Company has been organized under the laws of the State of New York, the incorporators being George E. Bouchie, Chas. B. Holder and O. M. Palmer. The capital of the company is $10,000,000, of which $2,000,000 is preferred and $8,000,000 common. The object of the company is to acquire the works of the American Ordnance Company, at Bridgeport, Conn., and other plants, to manufacture machinery as well as ordnance. It is understood that the American Machine & Ordnance Company expects to control the United States patents for the Hotchkiss rapid-fire gun, the Driggs-Schroeder system of rapid-fire guns, the Accles machine gun, the patent process of electric welding in the manufacture of projectiles now used in both the army and navy, the Fletcher and Dashiell patents of rapid firing breech mechanism and the Maxim patents. It also acquires a complete modern plant for the making of patterns and fine machinery.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Patterns and models. 19 Thames st., N. Y.

Stamping dies. Emmons Collins, Chicago.

We solicit inquiries for gear cutting. Benjamin Eastwood Co., Paterson, N. J.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Light machine & experimental work ; models made. S. Messerer, 15 Springf. av., Newark, N.J.

Wanted, for Cash—Bliss power press, geared No. 4 or 5 ; must be in good condition and price reasonable. Address T. A. C. Co., care AMERICAN MACHINIST.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings ; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Contract work wanted for small foundry and machine shop, used to doing good work only ; operated by owner, member A. S. M. E. Address Box 469, AMERICAN MACHINIST.

For Sale—One 24 in. semi-automatic turret lathe, built by American Turret Lathe Company ; machine good as new ; latest design. Curtis & Co. Mfg. Co., St. Louis, Mo.

For Sale—Course in drawing in the International Correspondence Schools ; regular price, without materials, $44 ; my price, including some materials, $25. Address Box 557, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis. ; lot, 100x180 feet ; machine shop, 32x68, two story, with line shaft and gasoline power ; foundry, 40x54, new modern equipment ; good location ; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Press work done at short notice ; blanking and drawing our specialty ; estimates cheerfully furnished ; tools for all work made on premises if desired ; copper, brass and nickel plating ; correspondence solicited. Acme Ball-Bearing Caster Co., Chappaqua, N. Y.

Wanted—Purchaser to buy patent setting instrument, patented Mar. 18, 1902 ; an O. K. tool for machinists, and every machinist needs one ; designed for different purposes ; of interest to small tool manufacturers ; send at once for circular. Morris Chamberlain, Bartley, New Jersey.

For Sale—Direct-connected outfit for immediate shipment ; one 10-16x12 Ideal tandem compound engine fitted with 75 K. W. Bullock 220-volt direct-current generator ; new (used only for exhibition purposes) ; also belted simple Ideal engine for quick shipment. A. L. Ide & Sons, Springfield, Ill.

For Sale—Well-equipped plant for manufacturing small and medium sized metal stampings ; 15 power presses, 3 foot presses, lathes, shaper, universal milling machine, etc. ; 8 miles from Philadelphia ; ready for immediate operation ; reason for selling, owner wishes to retire. Box 554, AMER. MACH.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine ; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R. ; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery ; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

General machinist ; good on small work. Box 544, AMERICAN MACHINIST.

Draftsman, electrical engineer, wants position. Box 548, AMERICAN MACHINIST.

Machinist, traveling salesman and manager, wants position. Box 559, AMER. MACHINIST.

Experienced mechanical draftsman, technical graduate, wishes position until October, or longer if satisfactory. Box 546, AM. M.

Experienced man on automatic machinery ; 10 years' experience, designer, superintendent, engineer ; practical, educated ; references. Box 505, AMERICAN MACHINIST.

By man, 35, superintendent or master mechanic, or to take charge of an experiment requiring deep study ; reference present concern. Box 517, AMERICAN MACHINIST.

Situation wanted by a practical, experienced machine shop foreman, 32 years old, with wide experience on small and medium work. Box 540, AMERICAN MACHINIST.

Graduate mechanical engineer, 1901, first-class designer, wants position in a steam engine or pump manufactory ; Corliss engines preferred. Box 557, AMER. MACHINIST.

Tool designer wants position ; expert at designing tools, jigs, fixtures, etc., for reducing the cost of manufactured articles. Wm. H. Flood, 308 W. 123d st., New York City.

Experienced machinery salesman, technical education, wishes to communicate with parties requiring the services of a competent representative. "Salesman," care AMER. MACH.

A practical machinist and draftsman, experienced in all kinds of plant, general machine and engine work ; have small shop, which I offer with services. Box 549, AM. M.

Mechanical engineer, graduate Stevens, several years' experience both mechanical and civil engineering, held important positions in Mexico, wants to change. Address Box 534, AMERICAN MACHINIST.

Mechanical engineer with brains wants a chance to use them for some concern that will appreciate results ; 43 years of age ; good character ; best references. Address "Results," care AMERICAN MACHINIST.

Mechanic, energetic, resourceful, who has successfully handled large contracts, experienced in wide variety of work, seeks position with concern that wants to cut costs to lowest practicable limit. Address "Competent," care AMERICAN MACHINIST.

Designer, experience in tools for interchangeable manufacture, special machinery and hopper feed work, desires position where man over 30, of inventiveness and energy, is wanted ; highest references. Address "American," care AMERICAN MACHINIST.

Mechanical engineer and designer, with broad experience covering intricate automatic machines, manufacturing interchangeable machinery, gasoline and steam automobiles, etc., desires engagement in engineering capacity. Address Box 541, AMERICAN MACHINIST.

A widely experienced superintendent and manager of machine works, expert in best shop practice and construction, of reliable executive ability and high-class references, seeks position with progressive and broad-minded concern. Address Y., 635 W. 61st St., Chicago.

Position desired as superintendent of manufacturing concern, by mechanical engineer with extensive experience on fine class of mechanical and electrical work ; thoroughly familiar with approved modern factory methods, piece-work systems, etc. ; excellent mechanical and executive ability ; highest references. Address Box 550, AMER. MACHINIST.

Assistant to superintendent or foreman manufacturing department, by an American, 37 years of age ; in small Western city preferred ; experience as foreman of tool and jig work, electric and scientific instruments ; able to do the finest tool work as well as to instruct others ; 18 years' practical and successful experience. Address "A," care AM. M.

Thoroughly first-class salesman, well posted in iron and wood working machinery, steam practice, etc. ; designer of plants ; accustomed to closing large contracts ; would go to Africa as salesman for a concern handling mining, steam, iron working and wood working machinery ; salary $6,000 and expenses ; am a cheap man for the right people. Box 555, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, with extensive American and European experience in designing of high-class gas engines for blast furnace, producer and natural gas, oil engines, producer plants, gas engine, compressor and dynamo plants, seeks position as superintendent or head draftsman ; first-class American and European references. Box 551, AMERICAN MACHINIST.

Help Wanted.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Two good, all-round patternmakers ; state experience and wages. Columbus Iron Works Co., Columbus, Ga.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Machinists, send for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—Half-dozen good molders to work on engine castings ; steady employment to good, reliable men. Address Ridgway Dynamo & Engine Co., Ridgway, Pa.

Machine draftsman wanted in Worcester, Mass. ; good opportunity for right man ; state experience, references and salary expected. Box 553, AMERICAN MACHINIST.

Wanted—Designer, thoroughly familiar with sheet metal tools and automatic can machinery, by responsible firm. Address, giving particulars, Box 556, AMER. MACHINIST.

Wanted—Experienced mechanical draftsman for position in New England States ; state age, education, experience and salary expected. Address Box 543, AMER. MACHINIST.

Wanted—Foreman for a large modern brass foundry ; must understand the mixing of metals, running machines and handling men ; state age, experience, wages expected. Address Box 552, AMERICAN MACHINIST.

Wanted—For moderate sized shop in central California, a first-class draftsman designer for engine and general work ; state age, experience, references and salary. Address Box 521, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman, to take charge of a switch and frog shop, as foreman; must have experience on steam and electric road work; give age, experience and references. Address C. S., care AMER. MACH.

Machinists wanted to act as shop agents and sell small tools where they work; send 44 cents for 6 in. tempered scale, No. 4, warranted; shall give a gold watch to some good agent. E. H. Randall, 235 Woodlawn ave., Springfield, Ohio.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—A thoroughly experienced and trained chief draftsman familiar with Corliss and high speed engines and competent to take charge of the drafting room of an active, working establishment. Address XX, care AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Bright and progressive diemaker, as foreman; one with extensive experience on combination and other dies for tin cans, etc.; applicants please give full particulars as to qualification for the position. Address Box 542, AMERICAN MACHINIST.

Wanted—First-class steam-fitter, thoroughly posted on high and low pressure work and general piping for manufacturing plant; must be sober and reliable, able to handle men, make sketches and lay out work; state age, pay expected and references. Address Box 514, AMERICAN MACHINIST.

Wanted—Foreman to take charge of shop in which fine trains of gearing for electrical instruments are made in large quantities, also fine tool work; must be first-class mechanic with experience in handling help. State experience and address your reply to "Foreman," P. O. Box 606, Newark, N. J.

Wanted—Foreman for machine shop, employing about 150 men, within 20 miles of New York; must be thoroughly competent to handle men, conversant with modern methods and automatic machinery, both medium and heavy; state age, experience, references and salary expected. Box 539, AM. MACH.

A man is wanted to inspect product of a manufactory, building engines and other machinery; he will be responsible to one man only, and that man superior in authority to the manufactory force; a good position for a mechanic who knows when work is well done and has the courage to so decide. Address Box 545, AMERICAN MACHINIST.

Wanted—A good mechanical draftsman for designing dies, tools and attachments to be used on presses and machines for working sheet metal; also experienced machinist to take charge of repair gang on general factory repair work; old, well-established and growing concern in central Connecticut; state age and experience in detail. Address Box 547, AMERICAN MACHINIST.

Wanted—A young man to take charge of toolroom; must be a good designer of jigs and tools, able to handle a small number of men successfully and get work through rapidly and economically; a man having a knowledge of sheet metal working tools preferred; applicant should state age, previous experience, pay expected, etc. Address Box 524, AMERICAN MACHINIST.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

Wanted.—A large Swiss firm, manufacturing all kinds of electrical engines, wants a first-rate foreman, capable of managing the whole factory; applicants are expected to possess a thorough knowledge of electrical branch, especially to be familiar with the construction of dynamos, and to have an extensive practical experience in the working of American machine tools; only men with long experience and great ability need apply; permanent position warranted if man engaged gives satisfaction. Address offers, stating age, experience, nationality, salary expected, recommendations, date of entrance, etc., to R. 2464 Q., care Haasenstein & Vogler, Basle, Switzerland.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co..... 92
Acme Machinery Co..... 18
Acme Steel & Mall. Ir. Wks... 98
Adams Co., The..... 80
Akron Electric Mfg. Co.....116
Albro-Clem Elevator Co..... 95
Alexander Mfg. Co., J. G.... 94
Allston Foundry Co.....111
Almond, T. R.....103
Alteneder & Son, Theo.....100
American Blower Co..... 79
American Ferrolix Co..... 78
American Fdry. & Mch. Co... 69
American Gas Furnace Co.... 15
American School of Correspondence.....115
American Roller Bearing Co.. 96
American Tool Works Co....126
Arguto Oiliess Bearing Co...102
Armstrong Bros. Tool Co.... 74
Audel & Co., Theo..... 69
Aurora Tool Works..... 80
Automatic Machine Co.....121
Automobile & Cycle Parts Co. 67

Backus Water Motor Co..... 95
Baird & Co., Henry Carey....131
Baird Machinery Co., U.....133
Baker Brothers....82, 100 & 132
Baldwin, Davidson & Wight..104
Balkwill Pattern Works..... 85
Ball Bearing Co..... 18
Barker & Chard Mch. Tool Co.133
Barnes Co., B. F.....122
Barnes & Co., W. F. & John.. 14
Barnett Co., G. & H...4th Cover
Bartlett, E. E.....107
Baush Machine Tool Co..... 70
Bay State Stamping Co., The.100
Bayldon Machine Tool Co..... 84
Beaman & Smith Co., The...
8 and 108
Belmer Machine Tool Co....109
Besly & Co., Chas. H.....
81 and 4th Cover
Bethlehem Fdry. & Mach. Co. 14
Betts Machine Co..... 5
Bickford Drill & Tool Co..... 12
Bignall & Keeler Mfg. Co..... 82
Bilgram, Hugo.....108
Billings & Spencer Co..4th Cover
Binsse Machine Co....18 and 113
Blaisdell & Co., P..... 84
Blanchard Mach. Co....18 and 99
Bliss Co., E. W..... 88
Blount & Co., J. G..... 89
Boker & Co., Herman.....118
Boston Gear Works.....105
Bowen Mfg. Co.....105
Bowers, Geo. W..... 88
Bowler & Co., Geo. H.....117
Bradford Machine Tool Co... 6
Bremer Machine & Tool Co... 69
Bienenstok & Co., E. A.....131
Bridgeport Chain Co.....110
Bristol Co.....4th Cover
Brown & Co., R. H.....108
Brown Hoisting Mch. Co....110

PAGE

Brown & Sharpe Mfg. Co....
68 and 4th Cover
Buffalo Forge Co.....4th Cover
Builders Iron Foundry..3d Cover
Bullard Machine Tool Co..... 16
Butler, A. G.....105
Byram & Co..... 92

Caldwell & Son Co., H. W....110
Carborundum Co., The..... 80
Card Mfg. Co., S. W..... 8
Carlin Machy. & Supply Co..132
Carpenter Tap & Die Co., J. M. 8
C & C Electric Co.....116
Case Mfg. Co.....110
Central Fdry. & Mach. Co.... 89
Chadwick & Co., G. B..... 89
Chambersburg Engr. Co..... 94
Champion Blower & Forge Co. 95
Charter Gas Engine Co..... 95
Chattanooga Machinery Co...104
Chicago Flexible Shaft Co...120
Chicago House Wrecking Co..131
Chicago Pneumatic Tool Co.. 99
Chicago Raw Hide Co..... 98
Chicago Ship Building Co....131
Christensen Engineering Co.. 99
Cincinnati Mach. Tool Co....128
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co..... 74
Cincinnati Shaper Co..... 18
Clark Auto. Telephone Switch Board Co..... 92
Clark, Jr., & Co., Jas.....134
Clayton Air Compressor Wrks. 99
Cleveland Crane & Car Co...110
Cleveland Gear Works..... 99
Cleveland Machine Screw Co.. 87
Cleveland Pneumatic Tool Co. 80
Cleveland Punch & Shear Wks. Co.....136
Cleveland Twist Drill Co....
4th Cover
Cleveland Wire Spring Co.... 95
Clough, R. M.....15 and 102
Coes Wrench Co..... 87
Columbus Machine Co..... 95
Commercial Electric Co.....114
Consolidated Engine Stop Co.127
Consolidated Schools.....116
Cook Co., Asa S.....103
Crane Co.....104
Cresson Co., Geo. V.....122
Crocker-Wheeler Co.....115
Cromwell, W. N.....104
Crosby Stm. Gage & Valve Co. 15
Cullen, Orlan Clyde.....104
Curtis & Co. Mfg. Co.....111
Curtis & Curtis Co., The..... 96
Cushman Chuck Co.....108

Dallett & Co., Thomas H....123
Davis Machine Co., W. P..... 72
Dawson Mchry. Co., J. H....131
Detrick & Harvey Machine Co. 94
Diamond Drill & Machine Co. 85
Diamond Machine Co...3d Cover
Dickinson, Thos. L..... 88

PAGE

Dixon Crucible Co., Joseph...131
Draftsman, The.....100
Dreses Machine Tool Co..... 93
Dunbar Bros..... 96
Dustin Co., Chas. E.....131

Elmes Engr. Wks., Chas. F... 84
Emmert Mfg. Co.....100
Errington Auto. Tap & Die Co.109
Estep & Dolan.....100
Etna Mfg. Co..... 94
Evans Friction Cone Co.....109
Excelsior Needle Co.....105

Fairbanks Co., The..132 and 133
Fairbanks Machine Tool Co.. 69
Faneuil Watch Tool Co.....136
Farrel Foundry & Mach. Co.. 98
Fawcus Machine Co.....133
Fay & Scott.....112
Fellows Gear Shaper Co.....129
Fenn Sadler Machine Co..... 91
Ferodowill & Co., J. H..... 95
Flather Planer Co., Mark...123
Flower & Co., Walter L..... 90
Foos Gas Engine Co..... 95
Fosdick & Holloway Machine Tool Co..... 90
Franklin Machine Works..... 73
Franklin Mfg. Co.....121
Franklin Portable Crane & Hoist Co.....110
Frick Co..... 95
Fulton Foundry & Mach. Co..122

Gang Co., Wm. E.....104
Ganschow, Wm..... 80
Garvin Machine Co., The....118
Gay & Ward..... 91
General Elec. Co.....114
Geometric Drill Co.....109
Gisholt Machine Co..... 97
Gleason Tool Co.1 and 4th Cover
Gobeille Pattern Works..... 18
Goodell-Pratt Co..... 77
Gorton Machine Co., Geo.... 17
Gould & Eberhardt..... 18
Graham Mfg. Co..... 83
Grant Gear Works..... 18
Grant Mfg. & Mach. Co..... 18
Grant Tool Co..... 97
Gray-Blaisdell Co.....120
Gray Co., G. A..... 18
Greaves, Klusman & Co..... 84
Greenfield Machine Co..... 76
Greenwald Co., I. & E.....105
Gump & Co., A. W.....133

Hall's Sons, Saml.....133
Hammacher, Schlemmer & Co. 69
Hampden Corundum Wheel Co.108
Hardinge Bros.....108
Harrington, Son & Co., Inc., Edw.....128
Harris & Co., Sam'l.....108
Hart Mfg. Co..... 94
Heald & Son, L. S..... 75
Hendey Machine Co..... 67

PAGE

Henley & Co., N. W..... 69
Hill, Clarke & Co..13, 111 & 133
Hill Tool Co..... 84
Hilles & Jones Co..... 84
Hisey-Wolf Machine Co.....112
Hoefer Mfg. Co..... 8
Hoggson & Pettis Mfg. Co...108
Hollands Mfg. Co.....116
Holmes, Chas. H.....123
Hopkinson Machine Works...122
Horsburgh & Scott....4th Cover
Horton & Son Co., E.....108
Houghton & Co., E. F..... 89
Hunt Co., C. W.....110
Hunt Co., Robt.....100
Hurlbut-Rogers Machine Co...111

Ingersoll Milling Mach. Co... 92
Ingersoll-Sergeant Drill Co... 99
International Corres. Schools. 89
International Steel & Mchry. Co..... 98
Iroquois Machine Co..... 97

Jantz & Leist Electric Co....116
Jeffrey Mfg. Co., The.....133
Jenkins Brothers.....104
Jones & Lamson Machine Co..
18 and 106

Kelly Machine Co., R. A.....117
Kempsmith Mfg. Co..88 and 133

Landis Tool Co.....123
Le Blond Machine Tool Co., R. K.....86 and 4th Cover
Le Count, Wm. G.....108
Leland & Faulconer Mfg. Co..103
Lieber Code Co..... 95
Link-Belt Engineering Co....131
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co..... 93
Lorentz & Evarts..... 94
Lunkenheimer Co., The.....104

McCabe, J. J.....129 and 132
McCrosky & Huber..... 96
Maris Bros.....111
Marshall & Huschart Mch. Co.133
Maxwell Engineering Co..... 95
Merrell Mfg. Co..... 92
Merritt & Co.....123
Messmer Mfg. Co., Ferd..... 98
Mich. College of Mines.....105
Mietz, August..... 95
Millers Falls Co..... 92
Miner & Peck Mfg. Co.....116
Mitts & Merrill.....128
Modern Tool Co.....116
Morse Twist Drill & Mach. Co. 17
Morse, Williams & Co..... 96
Morton Mfg. Co..... 96
Mossberg & Granville Mfg. Co.136
Murdock Parlor Grate Co....105

New Britain Machine Co.....134
New Era Iron Works Co..... 95
New Haven Mfg. Co..... 86

	PAGE
New Process Raw Hide Co.	135
Newton Mach. Tool Wks., Inc.	11
N. Y. Gear Works	102
Nicholson & Co., W. H.	83
Nicholson File Co.	67
Niles Tool Works Co.	3, 132 & 133
Nolte Brass Co.	109
Northampton Emery Wheel Co.	102
Northern Electric Mfg. Co.	114
Northern Engineering Works.	111
North Penn Iron Co.	110
Norton Emery Wheel Co.	75
Norton Grinding Co.	71
Norwood Bicycle Co.	111
Nuttall Co., R. D.	125
Nutter, Barnes & Co.	88
Obermayer Co., The	98
Oesterlein Mach. Co.	127
Olds Motor Works	95
Olmstead & Co., H. B.	94
Olmsted, L. M.	80
Osborn Machinery Co.	133
Owen Machine Tool Co.	135
Parker Co., Chas.	96
Patriarche & Bell	98
Patterson, Gottfried & Hunter Co., Ltd.	10
Pawling & Harnischfeger	110
Paxson Co., J. W.	100
Pearson Machine Co.	17
Phoenix Mfg. Co.	96
Phosphor Bronze Smelting Co.	94
Pierce-Crouch Engine Co.	95
Pond Machine Tool Co.	2
Poole & Son Co., Robt.	99
Potter & Johnston Co.	10
Pratt & Whitney Co.	101 and 3d Cover
Pratt Chuck Co.	79
Prentice Bros. Co.	123
Prentiss Tool & Supply Co.	132
Quint, A. D.	84
Rand Drill Co.	99
Reed Co., F. E.	81
Reed Co., Francis	94
Reeves Pulley Co.	112
Regal Gas Engine Co.	95
Reichhelm & Co., E. P.	78
Rhoades Mfg. Co.	94
Rich, J. & G.	15
Rivett Lathe Co.	136
Robbins & Myers Co., The	117
Rogers, Boat, Gage & Drill Works, John M.	121
Rogers & Hubbard Co.	96
Roller Bearing & Equip. Co.	18
Rue Mfg. Co.	95
Safety Emery Wheel Co.	102
Saunders' Sons, D.	96
Sawyer, Ezra	94
Sawyer Tool Mfg. Co.	122
Schacht Mfg. Co.	111
Schumacher & Boye	9
Schwerdtle Stamp Co.	109
Sebastian Lathe Co.	85
Sellers & Co., Inc., William	18
Seneca Falls Mfg. Co.	91 and 109
Shelby Steel Tube Co.	91
Shepard Lathe Co.	100
Shultz Belting Co.	18
Sibley & Ware	82
Simonds Mfg. Co.	105
Skinner Chuck Co.	108
Slocomb & Co., J. T.	84
Smith & Mills	98
Smith Fdry. Supply Co., J. D.	92
Snyder, J. E.	8
Spaulding Print Paper Co.	88
Sprague Electric Co.	116
Springfield Gas Engine Co.	95
Springfield Separator Co.	117
Standard Connecting Rod Co.	104
Standard Tool Co., The	79
Starrett Co., L. S.	119
Steptoe & Co., John	18
Stowell, J. A.	92
Streit Machine Co., A.	78
Struthers, Wells & Co.	95
Stuart's Foundry & Mach. Co.	4th Cover
Syracuse Twist Drill Co.	98
Thompson, Hugh L.	109
Toomey, Frank	133
Topping, J. R.	100
Towsley Mfg. Co., J. T.	85
Tracy, Robinson & Williams	94
Triumph Electric Co.	116
Troy File Works	112
Trump Brothers Machine Co.	103
Turley, H. G.	104
Turner & Co., F. L.	90
Underwood & Co., H. B.	105
Uniform Steel Co.	93
U. S. Metallic Packing Co.	88
U. S. Steel Co.	98
Vanderbeek Tool Works	105
Van Dorn & Dutton Co.	11
Vitrified Wheel Co.	11
Walcott & Son, Geo. D.	8
Waltham Watch Tool Co.	11
Walworth Mfg. Co.	3d Cover
Ward & Son, Edgar T.	9
Warner & Swasey Co.	101
Watson-Stillman Co.	13
Weber Gas & Gasoline Eng. Co.	9
Wells Bros. Co.	13
Westcott Chuck Co.	10
West Haven Mfg. Co.	82 and 4th Cover
Westmoreland Steel Co.	9
Whitcomb Mfg. Co.	9
Whiting Foundry Equip. Co.	11
Whitney Mfg. Co.	11
Whiton Machine Co., D. E.	10
Wilcox Mfg. Co., D.	9
Wiley & Russell Mfg. Co.	10
Williams & Co., J. H.	10
Williams, White & Co.	9
Wilmarth & Morman Co.	1
Windsor Machine Co.	1
Winkley Co., The	9
Woodman Mfg. & Supply Co., S.	94
Woodward & Powell Planer Co.	84
Worcester Mach. Screw Co.	88
Worcester Polytechnic Institute	105
Wormer Machinery Co., C. C.	132
Wyman & Gordon	4th Cover
Yale & Towne Mfg. Co.	135
Zeller, Geo. A.	85

Classified Index of Articles Advertised.

Abrasive Materials
Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Balls, Steel
Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Ball Bearings
See Roller Bearings.

Bars, Boring
Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearing Metal
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Bearings, Oilless
Arguto Oilless Bearing Co., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather
Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Bending Tools
Estep & Dolan, Sandwich, Ill.

Blocks and Tackles
See Hoists, Hand.

Blue Printing Machines
Spaulding Print Paper Co., Boston, Mass.

Blowers
American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boiler Washer and Tester
Rue Mfg. Co., Philadelphia, Pa.

Boilers
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Francis Reed Co., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Ballett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Books, Mechanical
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
The Draftsman, Cleveland, O.
Henley & Co., N. W., New York.
Holmes, Chas. H., Cleveland, O.
Zeller, Geo. A., St. Louis, Mo.

Brazing Material
American Ferrofix Co., New York.

Bulldozers
Williams, White & Co., Moline, Ill.

Carborundum
See Grinding.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Farrel Fdry. & Mch. Co., Ansonia, Conn.

Castings, Motor
Ferodowill & Co., J. H., St. Paul, Minn.

Castings, Steel
Acme Steel & Mall. Iron Works, Buffalo, N. Y.
Christensen Engineering Co., Milwaukee, Wis.
Farrel Fdry. & Mch. Co., Ansonia, Conn.
Uniform Steel Co., Newark, N. J.
U. S. Steel Co., Everett, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Conn.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chemicals
American Ferrofix Co., New York.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Fanuell Watch Tool Co., Boston, Mass.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
New Haven Mfg. Co,. New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Codes
Lieber Code Co., New York.

Collars, Split
Central Fdry. & Mach. Co., Reading, Pa.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray & Blaisdell, Bradford, Pa.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Couplings, Shaft
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelhia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
North Penn Iron Co., Phila., Pa.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.

Drawing Boards and Tables
Alexander Mfg. Co., J. G., Grand Rapids, Mich.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Phila., Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, Worcester, Mass.
Rhoades Mfg. Co., Columbus, O.
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Washburn Shops, Worcester, Mass.

Drilling Machines, Radial
Aurora Tool Works, Aurora, Ind.
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Radial
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Pierce-Crouch Engine Co., New Brighton, Pa.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Troy File Works, Troy, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Flower & Co., Walter L., St. Louis, Mo.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wilcox Mfg. Co., D., Mechanicsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Foundry Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, J. G., St. Louis, Mo.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Disc
Bayldon Mch. Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Bienenstok & Co., E. A., St. Louis, Mo.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Bienenstok & Co., E. A., St. Louis, Mo.
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Millers Falls Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Olmsted, L. H., Hasbrouck Heights, Mich.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Norwood Bicycle Co., Cincin., O.
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Holder, File and Tool
Bowers, Geo. W., Waltham, Mass.

Igniters, Gas Engine
Maxwell Engr. Co., Rome, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.
Woodman Mfg. & Supply Co., S., Boston, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachment
Bayldon Mch. Tool Co., Jersey City, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin.,
Automatic Mach. Co., Greenfie Mass.
Auto. Mach. Co., Bridgeport, C
Barker & Chard Mach. T. C Cincinnati, O.
Barnes Co., B. F., Rockford, Il
Barnes Co., W. F., & John, Roc ford, Ill.
Bement, Miles & Co., New York
Blaisdell & Co., P., Worceste Mass.
Blount & Co., J. G., Everet Mass.
Bradford Mach. Tool Co., Cin.,
Bullard Mach. Tool Co., Bridg port, Conn.
Davis Mach. Co., W. P., Roche ter, N. Y.
Diamond Machine Co., Provi., R.
Fairbanks Mch. Tool Co., Sprin field, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cin.,
Harrington, Son & Co., Edwin Philadelphia, Pa.
Hendey Mach. Co., Torrington, C
Hill, Clarke & Co., Boston, Mas
Le Blond Mach. Tool Co., R. F. Cincinnati, O.
Lodge & Shipley Mch. Tool Co Cincinnati, O.
Lodge & Shipley Mch. Tool Co Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reichheim & Co., E. P., New York
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Tracy, Robinson & Williams, Hartford, Conn.
Turner & Co., F. L., Orange, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co. Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Gleaves, Klusman & Co., Cin., O.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.
Olmstead & Co., H. B., New York.
Topping, J. R., Hartford, Conn.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mgf. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pulleys
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engineering Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua,

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Ball Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Massberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Sand Mixing Machines
Smith Foundry & Supply Co., J. D., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
Worcester Polytechnic Inst., Worcester, Mass.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
Springfield Separator Co., Springfield, Vt.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegeny, Pa.
Chicago House Wrecking Co., Chicago, Ill.
Dawson, John H., Chicago, Ill.
Dustin Co., Chas. E., New York.
Fairbanks Co., Philadelphia, Pa.
Gump & Co., A. W., Dayton, O.
Garvin Mch. Co., New York.
Hall's Sons, Sam'l, New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Osborn Mchry. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New Haven.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.

Shapers—*Continued*
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Squares
Turner & Co., F. L., Orange, Mass.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Herman Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Yard & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Herman Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburgh, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Fulton Fdry. & Mch. Co., Brooklyn, N. Y.
Garvin Mach. Co., New York.
Geometric Drill Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincin., O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Fdry. Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trucks, Shop
Towsley Mfg. Co., J. T., Cincin., O.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turrets, Carriage
Bolydon Mach. Tool Co., Jersey City, N. J.
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Hopkinson Mach. Works, Springfield, Mass.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

A New 10-inch Toolmakers' Lathe.

The accompanying half-tones and sectional view give a good idea of the general appearance and construction of a newly designed 10-inch toolmakers' lathe, which has just been put on the market by the Pratt & Whitney Company. The toolmakers' lathe of earlier design—made by this company and used in toolrooms throughout the country—is well known for its accuracy and convenience of operation. In the present design all of the desirable features of the older lathe have been retained, or slightly modified, and a number of new and valuable features—clearly shown in the illustrations—have been added.

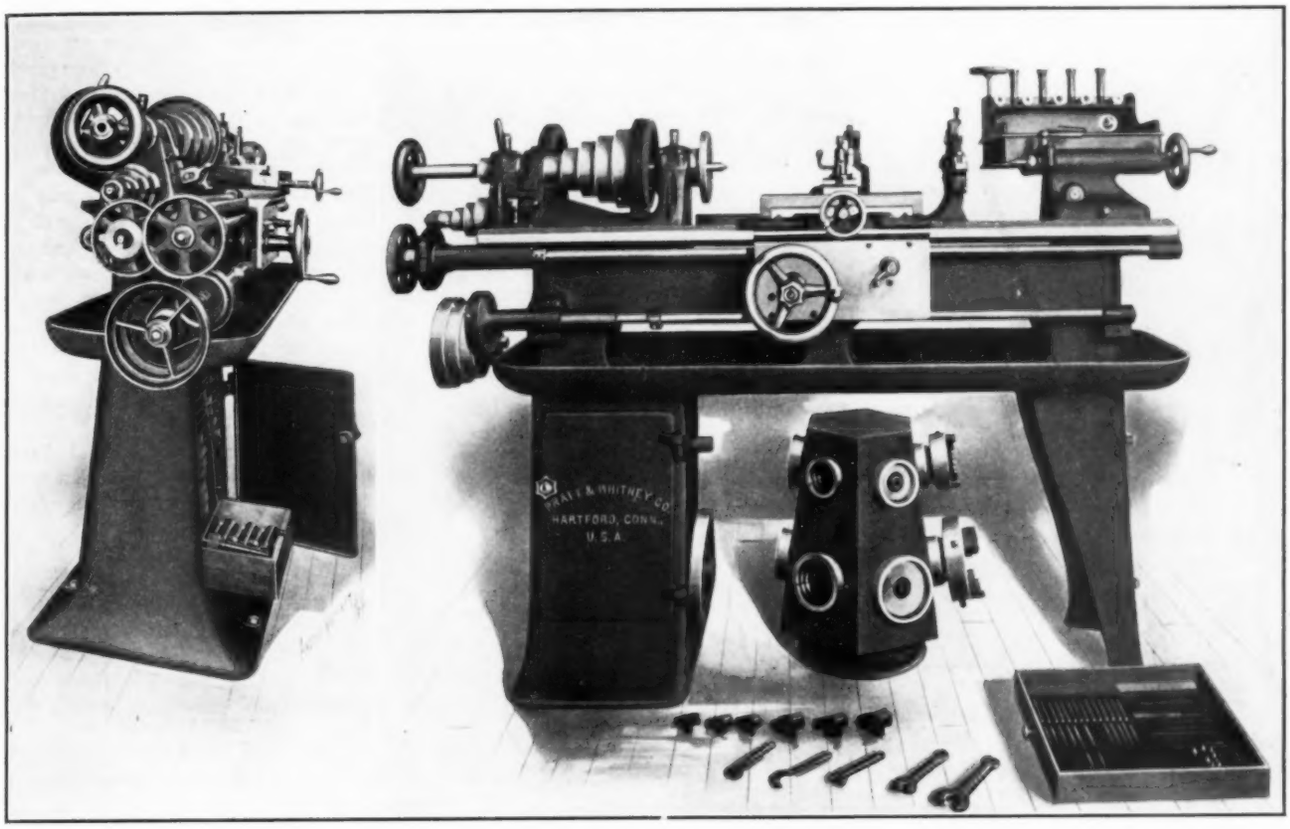


FIG. 1. 10-INCH TOOLMAKERS' LATHE.

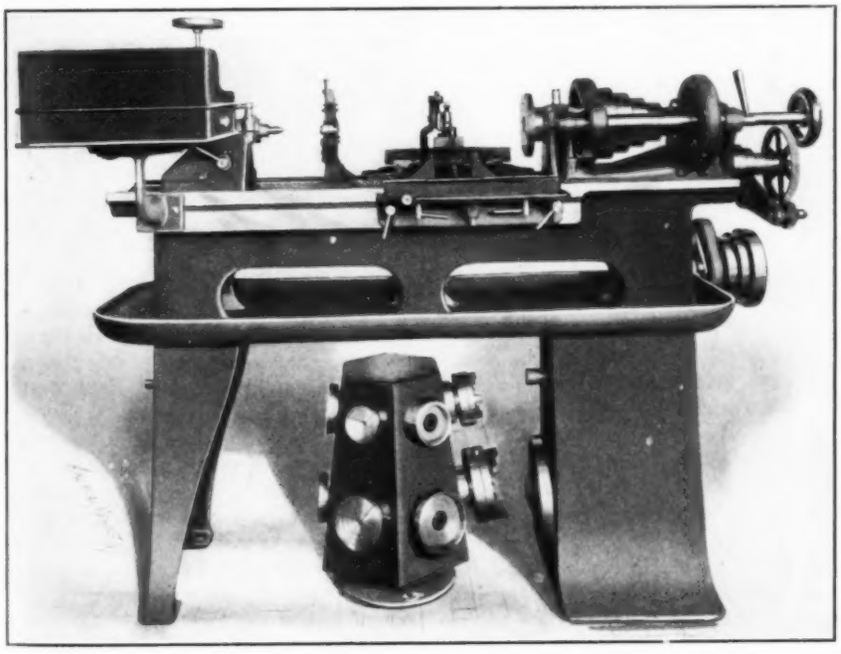


FIG. 2. 10-INCH TOOLMAKERS' LATHE.

The head spindle, which has a front bearing 1 11-16 inches in diameter and 3 inches long, is made of a selected crucible steel. It is ground and runs in carefully alined and hand-fitted cylindrical bearings of babbitt metal, cast solid into the head and cap, instead of into boxes as formerly, so that there are no extra joints to work loose and to cause chattering. Careful provision is made in seating the babbitt metal to have it secured solidly in position, before boring the bearings for the spindle, in order to obviate all spring that might otherwise result from the holes or pockets which are apt to form while the metal is cooling. There is a 15-16 inch hole through the head spindle, and as the lathe is designed especially for toolroom or other accurate work, it is

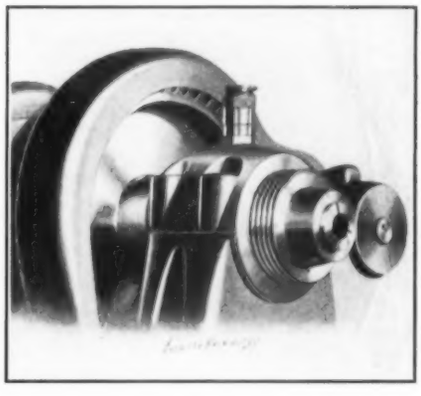


FIG. 3. SPINDLE NOSE.

provided with the usual hardened and ground draw-back collets, the largest taking 5/8-inch stock. Collets of the step chuck type are also furnished, and thus it is possible to hold short pieces of larger diameter than the spindle capacity.

The spindle nose, as shown in Fig. 3, is somewhat different from the usual design. The end of the nose is taper and is hardened and ground; the face-plate, chuck or other fixture being drawn up tight on the taper. The usual collar or flange at the back of the thread being done away with, the overhang of the spindle is reduced and the work is held nearer the front bearing.

The driving cone, which takes a belt 1½ inches wide, has five steps, the largest being 7⅛ inches and the smallest 2⅞ inches in diameter. With a countershaft speed of 150 turns per minute, the spindle speeds range from 8.4 to 384.8 turns per minute. The back gears give ample power for quite heavy work, the ratio of gearing being 7.8 to 1.

Fig. 4 gives a sectional view through the carriage and bed; the latter is cast in one piece with the pan and is very rigid. The carriage travels on and is guided by a large "V" at the front and has a flat track at the rear; it is gibbed to the bed and has an oiling device for lubricating the ways on which it slides. The "V's" for the head- and foot-stocks are somewhat lower and smaller than the carriage "V," thus permitting the carriage to be made with a deep and strong cross bridge.

It will be seen that the carriage is made up of a base, a top and a swivel. From the swivel at one end the top swings up or down. The tension on the carriage top is not by a weight, as heretofore, but by means of a coiled spring, one end of which is attached to the top at about its center, while the other end is affixed to the spring box fastened by screws to the carriage base. The carriage is thus more sensitive, the occasionally troublesome vibration caused by the inertia and momentum of a swinging weight is avoided, a greater cross feed is possible and the bed may be stiffened by cross girts. The cross feed screw—which has an adjustable micrometer dial reading to 0.0005 inch—is journaled in the swivel and fits a nut held in the taper bar connecting strap, so that adjustment of the cutting tool is always possible. Both screw and rod longitudinal feeds are provided. The rod feed has a three-grade cone and is arranged with an adjustable knock-off which will be appreciated by the workmen. The maximum and minimum rod feeds are 0.0152 and 0.0066 inch per turn of spindle. The rack and pinion are cut from steel and the worm runs in oil.

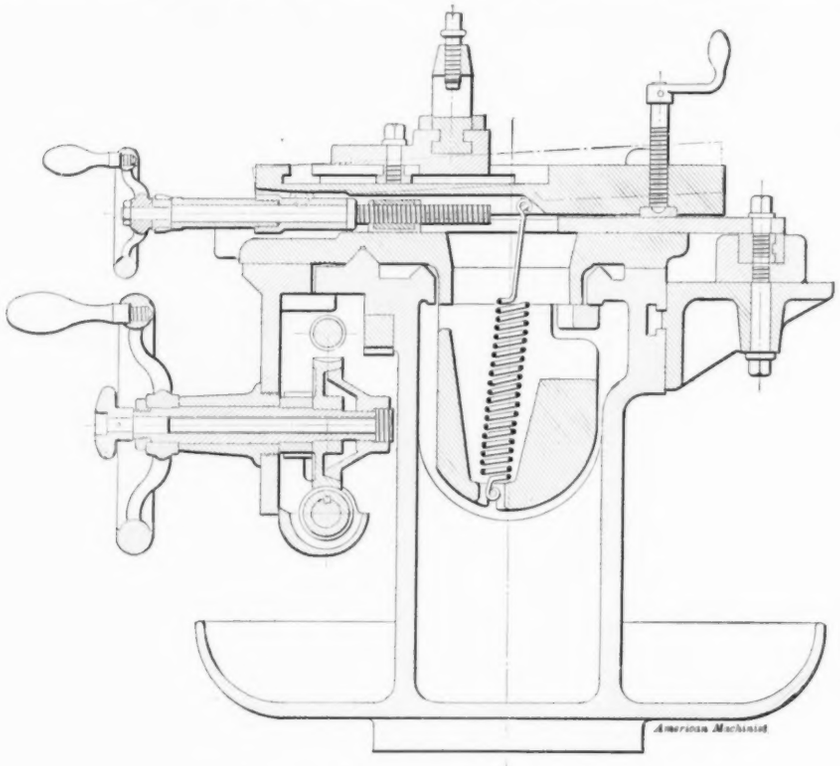


FIG. 4. SECTION THROUGH BED AND CARRIAGE.

The lead screw is quite large and so located as to be protected from chips and dirt.

In order to obtain an accurate lead screw the Pratt & Whitney Company have departed from the usual practice of cutting the thread in a lathe, and are instead milling the screw in a machine constructed especially for this purpose. The milling cutter is flooded with a stream of oil, thus keeping the work cool, and as the lead screw on the milling machine is very accurate, the lead screw produced is practically perfect; indeed the company guarantees the lead to be correct within a limit of 0.001 inch per foot.

The taper turning attachment is very simple and of few working parts, with the clamping and adjusting mechanism located so as to be easily manipulated by the operator from in front. The base on which the taper bar swivels to obtain the various tapers is graduated on one end in degrees and fractional parts, and on the other end in tapers per foot. Minute adjustments may be obtained by screws. The base is attached directly to the bed and may be positioned either close to the headstock or at any desired point between head and end of bed, and when clamped is practically solid. The only moving part of the attachment when in use is the taper bar block, and this is composed of two wedge-shaped pieces which may be adjusted so as to always closely fit the guide-way in the taper bar.

To change from cylindrical to taper work it is necessary only to release a binder which clamps the taper bar connecting strap to the carriage base and fasten the taper bar block in position.

Not all of the appliances shown in the half-tones regularly accompany the lathe, some being furnished only to order. In the regular equipment are included—in addition to the attachments usually furnished with lathes—nine draw-back collets taking round stock from ⅛ to 5/8 inch in diameter.

The lathe is fitted with either English or metric lead screw. With the English screw it will cut from 1½ to 156 threads per inch; or metric threads from 13 to .25 m/m pitch. With the metric screw it will cut threads from 20 to .50 m/m pitch; or from 1½ to 39 threads per inch.

The lathe swings 10¾ inches over the bed and 4 13-16 inches over the carriage; the bed is 5 feet long, and the greatest distance between centers is 29 inches. The countershaft pulleys are 8 inches in diameter by 2¾ inches face. The total weight of lathe with attachments is 1,430 pounds.

Echoes From the Oil Country.

PATCHING A LOCOMOTIVE CYLINDER.

Christmas day is usually given over to festivities, and a boy usually gets that day for recreation, even if work does press a bit at other times; but when the boy got an invitation to go along with the owner and look at a job on a locomotive, he thought it just in the line of enjoyment. It wasn't every shop owner who would say to a boy, "I would like to have you go along and see what you think about putting a patch on; there is a piece broken out of one of the cylinders." Go along? What boy wouldn't be glad of the chance to go along, Christmas or any other day?

The locomotive ran on a railroad that was used to bring the coal from the Cranberry mines. It was the entire motive power, and when it was laid up, the entire traffic was at a standstill, unless there

were cars at the mines. In that case they could be run down by gravity, as the road dropped something like 500 feet in 4½ miles. But gravity wouldn't—at least in this part of the country—pull them up again, so it was urgent that repairs be made quickly.

Arriving at the shed where the locomotive was kept, a short examination showed a very bad break in the front end of one of the cylinders. Something had got loose inside, and instead of knocking out the cylinder head it had by some strange combination broken out a triangular piece of the cylinder, taking a piece of the flange and extending back several inches along the bore of the cylinder. The part broken away was in several pieces, so it could not be replaced by putting a patch outside, and the owner of the shop decided he could make a pattern and cast a piece that would act as a patch and still give a good surface for the piston to wear on.

This was the winter following the one when the boiler at the shop had to be patched, and the shop now boasted a foundry that gave employment to an entire man part of the time, and was able to turn out brass or iron castings on short notice, and of a quality, sometimes, the like of which it would be hard to find in any of the large foundries in the country. Like the steamboat Dickens spoke of riding on in his Western trip, size was a poor word to use in describing it; but some idea can be gathered from knowing that when a job of making a boiler front was taken in, it was found that there was not room to roll the mold over—or so at least the molder figured it out. He couldn't find room enough, and for a time it looked as though the side of the building would have to be torn away and the flask lugged out of doors to be turned, but finally the owner demonstrated that there was one way that job could be turned. It isn't every foundry that takes in work so large they have troubles of that kind. That molder sometimes sends letters back to let his old friends know he is still prospering, and in one of his latest he spoke of the molding he used to do in a dog kennel. You can see his recollection of the size of that foundry. It's bigger now.

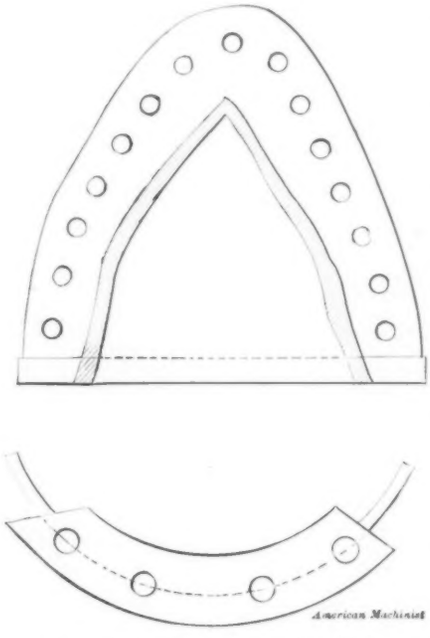
The question of the way to get a patch for the cylinder having been decided, the boy was told he was to have the job of dressing up the cylinder and fitting the patch to place and putting it on, and was told to get ready the next morning and rough dress the edges of the break, take some sizes so that a pattern could be made for the patch, and to take off the manhole plate on the dome and do a little repairing in any way it might be needed, as a boilermaker was coming on and was to put a patch on the boiler.

The boilermaker that came on was a good workman sometimes, and sometimes he was drunk. He was evidently changing from one condition to the other on this job, and on one occasion when he returned from a trip to the shop—his shop, not ours—he brought back a couple of bottles of beer, which he proceeded to hide in a pile of coal. He invited the boy to help himself if he cared to, but told him at the same time it was a very bad thing to do, and that he himself never indulged, except for his health, which demanded it.

The owner of the locomotive evidently had prejudices against a man with such health, as after dinner of the second day Jack came over and began to gather up his belongings.

"Hello, Jack! You're not going away before you get that patch done, are you?" The patch was a mean one to bend, being on the corner where the top, front and side joined, and was not yet properly fitted.

"Go 'way? Of course I'm going. Do you think I would work on an old scrap pile like this for a man like this fellow is? What do you think he done, anyhow? You couldn't never think. He went over



PATCHING A LOCOMOTIVE CYLINDER.

to the shop and he asked the boss was I competent to do this job. Just think of that, now, if you can! Competent—me competent! A man that owned a thing like this to say a thing like that to my boss. Now they've got to send another man to put his old patch on for him." The man who came in Jack's place, after looking at Jack's patch and the place and taking a few measures, went to the shop, and when he returned he had a patch that fitted so well that he proceeded to put it on.

In the meantime the boy received his patch from the shop. It looked something like the sketch and was without any dressing or machine work, except the small holes. The holes in the flange were to be drilled in after the patch was in place. Owing to the angles that the surfaces formed to one another, it was largely a job of cut and try with him, and the way to make it all draw up together tight at the last was not altogether clear, while the angles of the tap bolts that were to hold the patch on did not make the job any simpler.

A visit from the boss gave him a few pointers that showed chiefly where better time could have been made. If anyone imagines that good time was made on this job he wants to try lying on his back in a shed in the winter, with a railroad rail for a pillow and a torch for light, and try to do a nice job of fitting, and he may understand that such conditions do not tend to make quick jobs, especially when done by a green boy.

However, in the course of time the fitting was done and the holes ratcheted into the cylinder and tapped, and the patch was ready to go on. To try to head off anything that might leak out of the crack some hemp packing was chopped up fine and thoroughly mixed with red and white lead and the mixture spread on to the patch, a very little lead without the hemp being put on the joint. A couple of holes, one on each side, had been filed out a little oblong, so as to catch and draw up the patch, and by using the ratchet as a jack the patch was forced up until these caught and were screwed in. Then one after the other the remaining ones were induced to go in, although in some cases the tap had to be run in a thread or two before they would start. When the patch was pulled up as tight as it would go after a good hammering, the part inside was dressed out with a hammer and chisel to conform with the rest of the cylinder and the ends of the tap bolts cut off, the finish being put on with a file and half-round scraper, a piece of sheet iron filed to the circle of the bore serving as a gage.

The face joint was a ground one and was gone over in the same manner, and the outside of the flange got a dressing to make it the right size. After the stud holes were drilled and tapped and the studs were in place, the job was considered about done, especially as it had been decided to use a piece of paper as a packing in the joint.

After the boss looked the job over carefully he decided that a band around the flange would be an improvement, and took a measure of it to make the band from. Thinking the band might need some drawing to make a good fit the blacksmith came over to put it on. The boy was not pleased to see that the band was able to draw things much tighter than the bolts he had put in and spoil his nice fit in the cylinder; but it did not take a great while to dress it to the diameter again, and the paper evidently made up for the slight displacement in front.

When everything was in place and the engine was run up the road a ways and back, it showed only a few drops of water and no signs of steam, and was pronounced a good job by those most interested. This test was made on New Year's

day, but the boy was too much interested to see how it would be, to care that he was losing another holiday.

Many may think it would have been cheaper to tear off the cylinder and take it to the shop to do the job; but where machinery is old and facilities are few for handling heavy pieces, a cylinder 16x24 inches seems big under some conditions, and it is hard to know where one will end when he begins to tear things to pieces.

I well recollect taking a cylinder off a steam engine once. We had agreed to rebore the cylinder and put in a new head for a certain price, with the understanding that the owner would bring in the cylinder. So he did—and the bed with it. "I didn't have tools to take it off with, so I just hauled it all in. Your fellows have plenty of tools and can slip it off in a very few minutes."

I was given the slipping-off job to do, and worked over four hours with a boy to help me doing it. I wished I had the designer of that engine there while I bossed the job and made him take it apart. Not satisfied with putting a hood out over the nuts, he had re-enforced it with a rib that extended inward, effectually preventing a wrench from reaching. A big round flange to hold the gland studs stood about in line with the end of the hood and did not help matters. To finish off with, a pocket had been cored in where each nut came, and this pocket was only wide enough to let the nut unscrew two or three threads before striking. Then the others had to be unscrewed a little and the cylinder wedged off some and the operation repeated.

The man who made that engine was counted a practical man—I chanced to become acquainted with him—but he couldn't have done worse if he had been fresh from college.

Naturally, the boss did not like the amount of time I took getting that cylinder off, and another man had the job of putting it on. With the help of two boys he got it on in a little more than half a day. Of course, the man objected to paying anything for just screwing off a few nuts and slipping a cylinder off when we were getting the job of reboring it.

W. OSBORNE.

The Krupp Works and the Dusseldorf Exhibition.

Among the most striking features of the exhibition at Dusseldorf, this year, is the magnificent display of Fried Krupp. Not only will the productions of the parent works at Essen be adequately represented, but also those of the outlying works: the former Asthower Steel Works at Annen, the Gruson Works at Buckau, near Magdeburg, and the shipbuilding yard at Kiel.

FIG. 1. THE KRUPP PAVILION AT DUSSELDORF.

Fig. 1 gives a general view of the Krupp pavilion at Dusseldorf, and Fig. 2 is a plan of the same. It covers an area of 4,280 square meters (52,800 square feet), against 1,815 square meters at Chicago. The main hall is 360x85 feet. In the southern annex is placed a mast piercing the roof, with fighting tops fully equipped. The iron construction of the building was executed and erected by the steam boiler forge of the Essen Works. The first drawings were handed in at the shops in February, 1901. The first arch was erected early in June, and all the arches were completed in August. The building will eventually be re-erected as a workshop in one of the Krupp establishments.

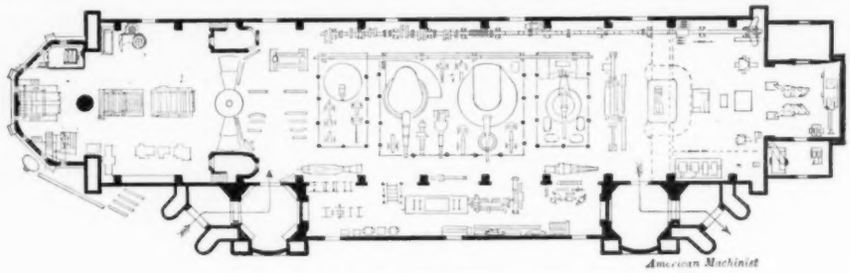


FIG. 2. PLAN OF THE KRUPP PAVILION.

Of the exhibits from the Essen Works the world-renowned ordnance is most prominent. Here may be seen a 30.5-centimeter (12.1-inch) coast defence gun in turret mounting, a 21-centimeter (8.26-inch) coast defence gun in disappearing mounting, a 15-centimeter (5.9-inch) coast defence gun in central-pivot mounting and a 28-centimeter (11-inch) coast defence howitzer, besides a 28-centimeter and a 19-centimeter (7.5-inch) quick-firing naval gun on central pivot mounting. Field ordnance is represented by several 7.5-centimeter (2.95-inch) field guns of the latest construction, field howitzer mountain guns and several small caliber guns. All this ordnance material is fully equipped ready for use, and systematic collections of breech closing mechanisms, projectiles, cartridge cases, various types of fixed ammunition, etc., complete this section of the exhibits.

The manufacture of armor plates at the Essen Works is illustrated in a most instructive manner, both with respect to its gradual development and to its actual achievements at the present day, by a number of plates which have undergone firing tests, viz.: compound plates, plates of soft nickel steel, plates for armored decks and, last, not least, objects of armor made of cast and hardened nickel steel (a new invention in the domain of armor plate manufacture). There are about twenty-five heavy pieces of armor exhibited, and among these one which, no doubt, is the largest and heaviest plate ever made, its weight being 106 tons, and its dimensions 13.150 by 3.400 by 0.300 meters (43.13x11.15x.984 feet).

Not many outside engineers are permitted to see the inside of the Krupp works or to watch their processes in detail. Our readers therefore will appreciate the views here presented in connection with this mention of this immense piece of armor plate. Fig. 3 shows the operation of lifting the ingot from which this plate was rolled out of the casting pit. They evidently know the value of daylight at these works and make generous provision for its admission. Fig. 4 shows the operation of placing the ingot upon the movable hearth of the reheating furnace, two cranes being employed for this purpose. This view shows still better the shop construction and the windows and skylights. Fig. 5 shows the operation of rolling the plate.

As at Chicago, Krupp also exhibits at Dusseldorf a number of forgings of imposing dimensions. The hollow shaft of 25 meters (82 feet) length made of crucible steel, weighing 12 tons, forged from one ingot and bored its entire length, which created quite a sensation at Chicago, is surpassed at Dusseldorf by a similar

shaft of superior dimensions. It weighs about 50 tons and has a length of 45 meters (147.6 feet). Its exterior diameter is about 540 millimeters (21.26 inches) and its interior diameter about 120 millimeters (4.72 inches). This piece is of no immediate and practical use; it only serves to convey an idea of what the Essen workshops and the power of their plant are able to produce in this line. Alongside this piece the complete shaft of the liner "Kaiser Wilhelm II," of the North German Lloyd, awakens the interest of the spectators. When completely put together and fitted with the screw this shaft will have a total length of 71 meters (233 feet) and will weigh 226,200 kilograms (248 tons).

Fig. 6 shows the crank portion of this shaft nearing its completion in the lathe. The several pieces have evidently been recently assembled and the couplings are being finished.

A large number of steel castings are exhibited, among which are the stem, the stern post and the rudder frame of a line-of-battle ship of the "H" class and many of smaller size, interesting by reason of various peculiarities.

The steel sheet manufacture of the Essen Steel Works is represented, among other things, by a sheet 26.80 meters long, 3.65 meters broad and 38.5 millimeters thick (88x11.97 feet by 1.5 inches), weighing 29.5 tons, the largest surface, perhaps, that has ever been rolled. There are a number of articles made of sheet steel of special forms, some molded by pressing, others by drawing out and others by forging in dies—among these a stern post for a torpedo boat.

In connection with the sheet steel manufacture we show in Fig. 7 a hydraulic shearing machine at the Essen Works. This machine cuts plates up to 70 millimeters (2.75 inches) in thickness. The truck seen at the right, evidently used in connection with sheet cutting, it will be seen, has movements in each rectangular direction with a rotating table at the top.

The shipbuilding yard Germania is represented by a great number of models of ships built in their yards and by numerous marine engines for diverse purposes. Besides, they exhibit a steam boiler plant, Schulz patent, which will furnish the steam for the dynamo actuating the motors of the turret mountings.

Krupp's extensive institutions for the welfare of his officials and workmen are illustrated in detail by numerous drawings, models, tables, stereoscopic views, etc., displayed in a room of the upper story of the northern tower. The monotony generally inherent to exhibitions of this kind has in this case been avoided by a suitable arrangement of the material, relieved by ample illustrations in the shape of pictures and photographs.

As a sort of introduction to the actual productions of the Krupp Works, the entrance apartments on the southern side contain collections of the raw materials to which the various articles of production owe their origin, and which Krupp draws from his own coal mines, metal mines, pits, quarries, etc. Among these collections there is one containing mineralogically interesting pieces found in the iron-ore mines. Productions at intermediate stages of manufacture, such as cast blocks, slabs, ingots, as also auxiliary productions, such as crucibles and other articles made of fire-proof material, are arranged by way of decoration in the apartments contained in the northern tower, which is in the line of exit.

The exhibit as a whole is perhaps the most adequate and comprehensive ever made by any establishment, and it abounds throughout with instruction for the engineer and the manufacturer.

FIG. 3. IN THE KRUPP WORKS AT ESSEN. LIFTING THE INGOT FOR THE 106-TON ARMOR PLATE FROM THE CASTING PIT.

FIG. 4. PLACING THE INGOT ON THE MOVABLE HEARTH OF THE REHEATING FURNACE.

FIG. 5. ROLLING THE 106-TON PLATE IN THE ARMOR PLATE MILL AT ESSEN.

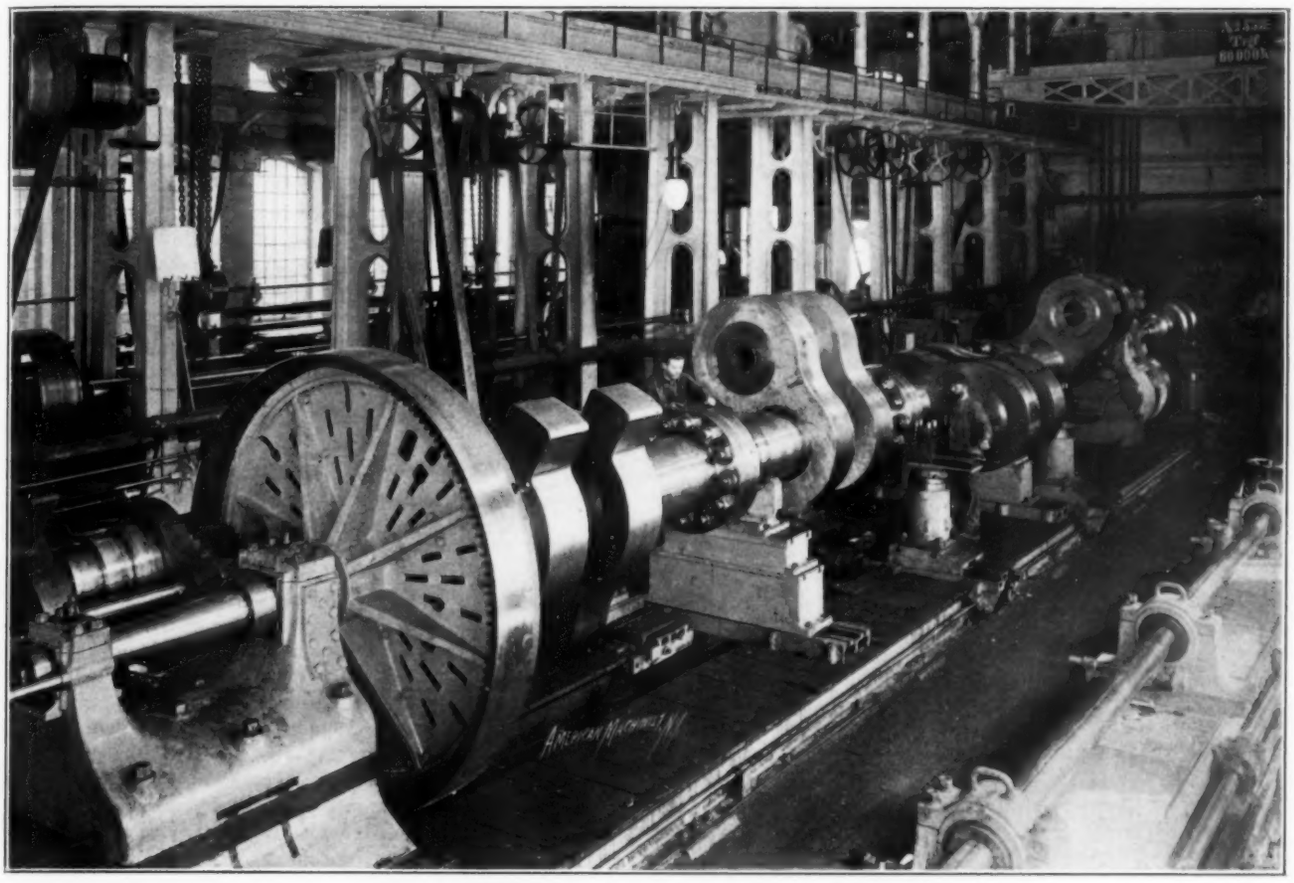


FIG. 6. SIX THROW CRANK-SHAFT IN THE LATHE. FOR NORTH GERMAN LLOYD LINER "KAISER WILHELM II."

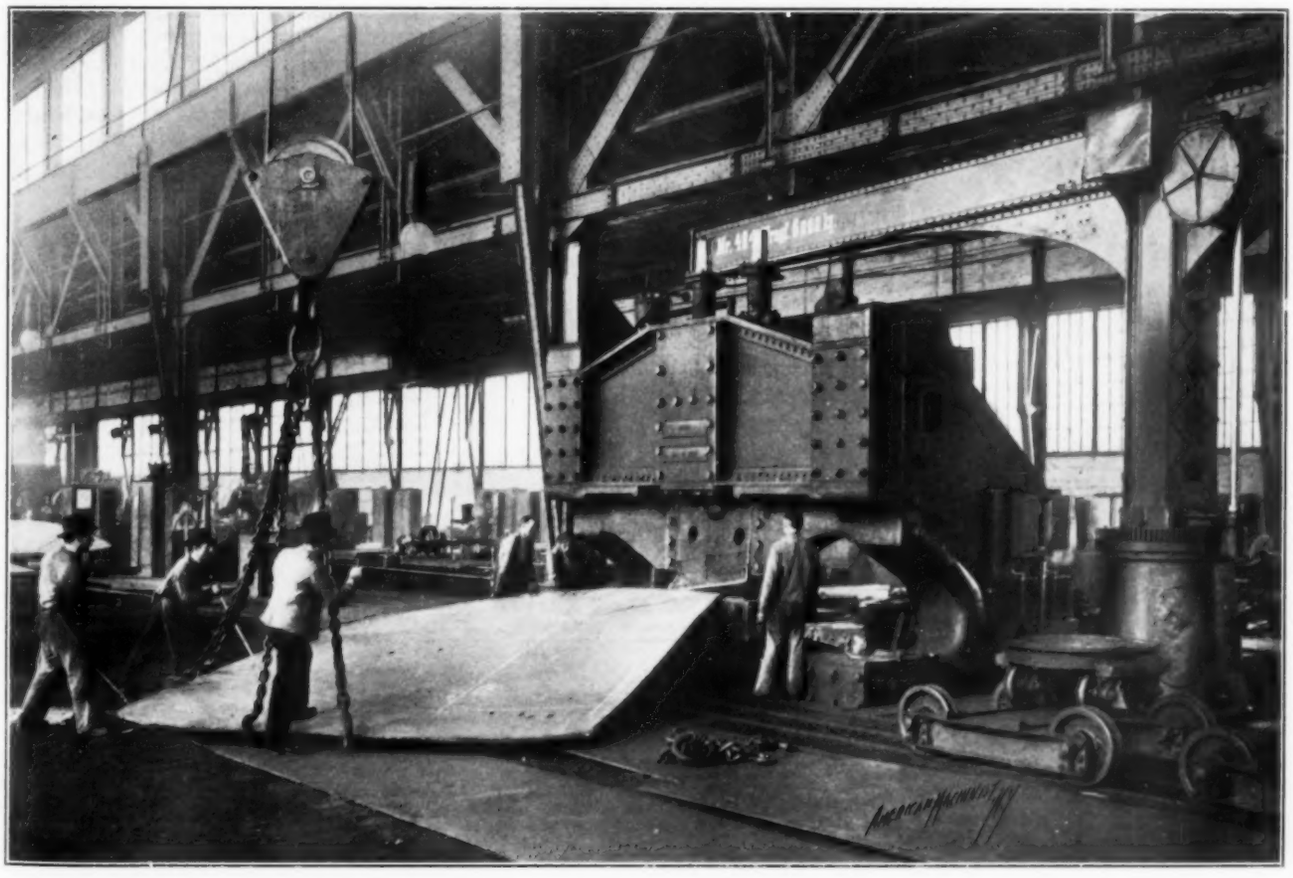
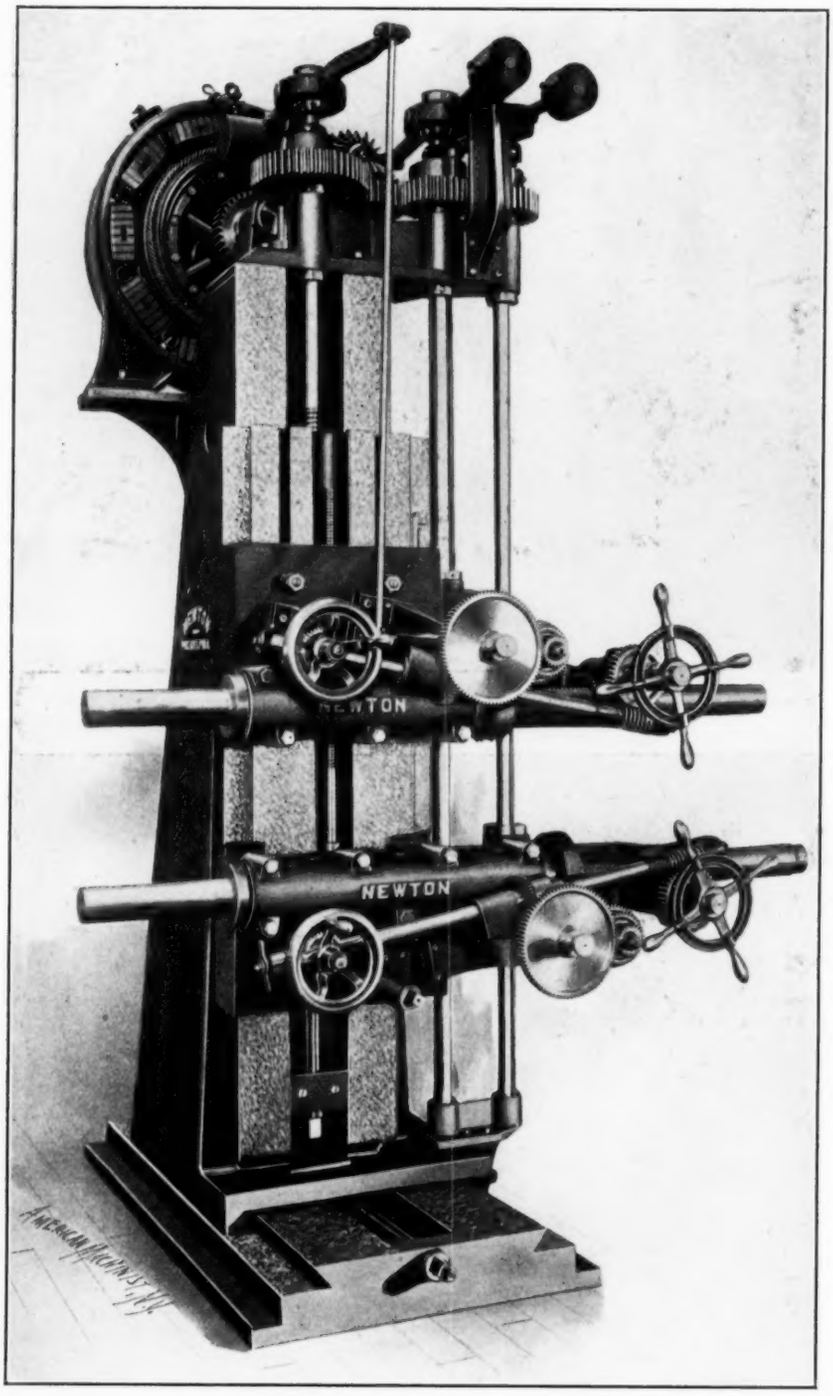


FIG. 7. HYDRAULIC SHEET SHEARING MACHINE AT THE ESSEN WORKS.

Portable Double Spindle Drilling Machine.

The growing use of the floor-plate-portable-tool system of doing large machine work lends interest to the tools which are being developed for that system, of which the accompanying illustration shows the most recent. It has been made by the Newton Machine Tool Works for the General Electric Company, and is for drilling the holes in the faces on large generator frames to which the field cores are bolted. The frame lies upon its side on blocking pieces resting on the slotted floor plate, and, if need be, while slotting or other work is being done on the frame, this drilling machine may also be at work.



PORTABLE DOUBLE SPINDLE DRILLING MACHINE.

The lower head is cast as part of the long main slide which is fitted to the frame. The upper head is mounted on a supplemental slide fitted to the main slide, and an adjusting screw regulates the distance between the spindles, the range of adjustment being from 6½ to 30 inches between centers of spindles. With the distance adjusted and the upper spindle head clamped to the lower one, both may be raised or lowered by power through the screw shown in the recess of the column and the clutch above. The horizontal cross adjustment is by the hand-operated screw in the base. The spindles are driven together or independently through the upright shafts at the right, which also drive the feed gearing. The power feed has three rates. It may be disconnected and a hand feed be obtained through the left-hand hand wheels, and by disconnecting a clutch connected to each of the right-hand pilot wheels, a quick hand traverse to the spindles is obtained. The extreme range of work is from 24 to 84 inches above the floor plate, and the spindles have a feed of 30 inches.

The General Scheme of the New Milwaukee Plant of the Allis-Chalmers Company.

When beginning the layout of this great plant Mr. Reynolds remarked that throughout his life he had been building additions and adapting his plans to controlling circumstances and conditions, but that in laying out these works he proposed to reverse this procedure and design the plant without regard to any location or site, and then select a site which should be suitable to the desired plan. This program has been literally followed and there is now arising at West Allis—a suburb of Milwaukee—a magnificent plant which is, in this respect at least, unique. The site selected contains 100 acres.

It has come to be accepted that a fundamental feature of correct shop design is facility for indefinite enlargement, but we doubt if that feature has ever been solved in so complete a manner as in the present case. Facility for indefinite enlargement is one thing, but facility for such enlargement with a constantly maintained balance of floor area between the different departments is quite another, and it is to this feature of the plans that Mr. Reynolds has devoted particular attention. The striking feature of the new works is that, starting with a carefully balanced floor area in the various departments, the plant as a whole may not only be expanded indefinitely, but in such expansion the balance may be preserved.

The starting point of the design was the determination of the floor areas of the various departments of the existing works. It may be set down as a matter of course that in a large old works which has been built up by successive additions, the relative areas of the departments will be substantially correct. In the nature of the case the additions are made where most

Department.	Total Sq. Feet.	No. of Men Employed.	Relative Areas.	Sq. Ft. of Floor Area per Man.
Machine shop.....	276,484	966	1.	331
Erecting shop.....	43,425		.158	
Foundry	142,984	607	.520	235½
Pattern shop.....	28,643	80	.104	358
Carpenter shop.....	46,910	100	.171	469
Pattern storage.....	82,870	....	.297	....
Blacksmith shop....	11,830	65	.0435	182
Office building.....	40,170	175	.146	229½
Drawing office (included in office bldg)	11,330		.041	

FUNDAMENTAL DATA FOR THE LAYOUT OF THE WORKS.

needed, any department which is behind the others in capacity when enlargements are being made, being the one selected for enlargement. At any stage of the process the plant as a whole may be too small, but no one department can materially exceed the others in capacity.

A survey of the old works was therefore made, with the result shown in the accompanying table of Fundamental Data. Referring to the table, it will be noted that as regards the men employed and the floor space per man, no distinction is made between the machine and the erecting shops. This is for the obvious reason that many of the men are constantly passing from one to the other, and the distinction is therefore impossible. A similar lack of distinction will be observed regarding the drawing office and the rest of the office building, the explanation in this case be-

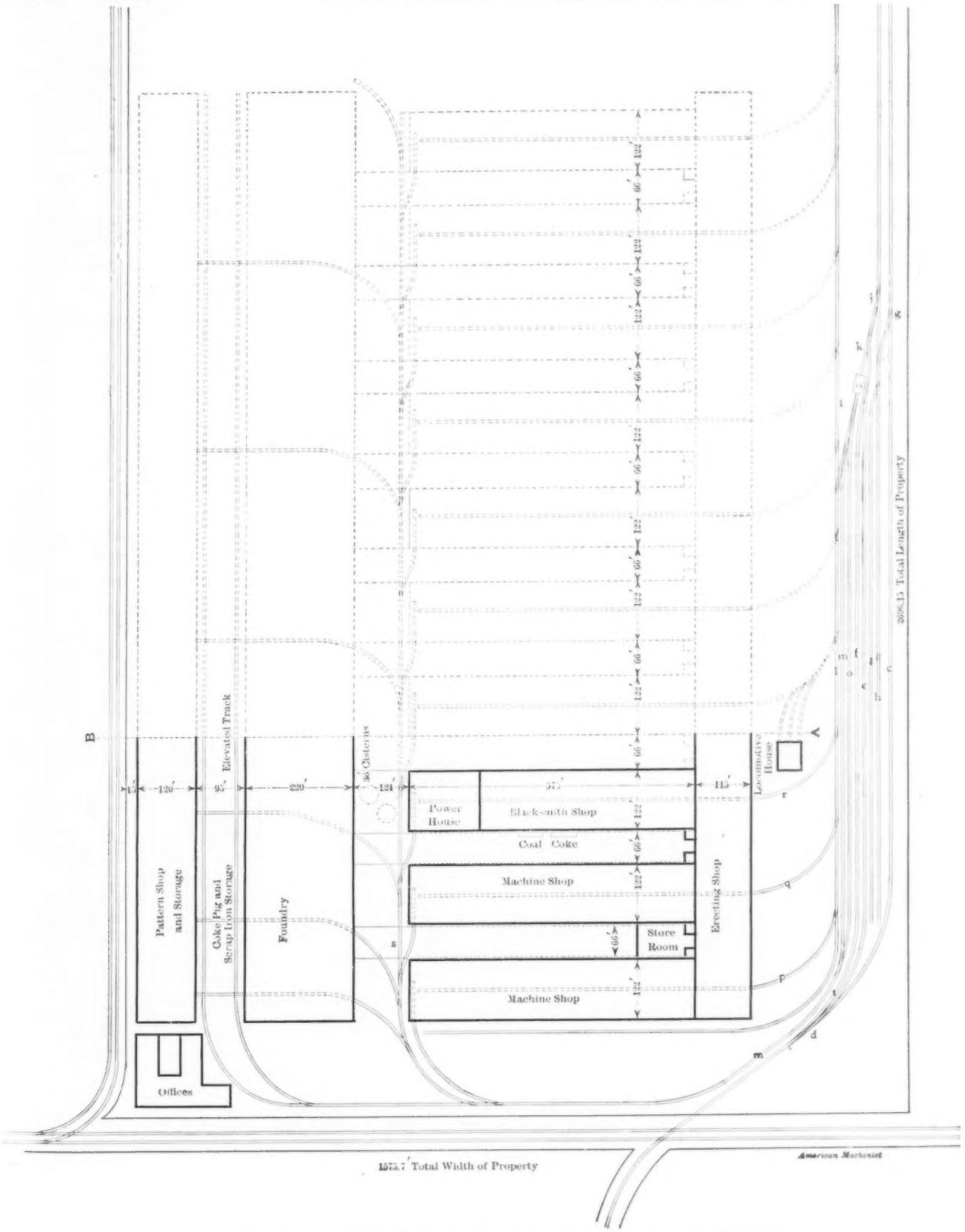


FIG. 1. GENERAL PLAN OF NEW MILWAUKEE WORKS OF THE ALLIS-CHALMERS COMPANY.

ing that when the table was made out the detail plans for the office building were not complete.

In applying this table to the new works two changes were made. The new shop will be equipped throughout with new modern tools from which an increased output is naturally expected. These tools are, moreover, to be electrically driven, from which additional advantage is expected. To supply such a shop with castings the new foundry is to have its floor area increased by one quarter over what the figures of the table would indicate. The other change is in the pattern storage, in which the factor of volume, rather than floor area, enters, as well as the factor of time, and this department has therefore been treated independently.

The table contains a line devoted to the carpenter shop, which department does not appear in the new works. The need for such a department in the old works arises from the work done in fitting out flour and saw mills, but as this work will not be moved to the new shops the carpenter shop does not appear in the plans for them.

Fig. 1 shows the general plan of the works, the buildings outlined in full lines being the ones which are now in course of erection. Seven additional wings are shown in dotted lines and these will be added as required. Taking a section on the line *A B*, everything below it comprises a unit so far as machine shop, erecting shop, foundry and pattern shop and storage are concerned, the floor areas of these various departments being in accordance with the determinations already given. It is clear that when additions are made to all departments by whole units up to section lines corresponding to *A B* in position the relative areas of the departments named will not be disturbed. So far as the blacksmith shop is concerned, the balance will, however, be disturbed unless three units are erected at a time, one of them being another blacksmith shop.

What appears in Fig. 1 as the erecting shop is in reality two departments—one devoted to erecting and the other to shipping. The cross-section of these departments is shown in Fig. 2, the high space at the right being the erecting shop proper, while the lower one to the left is for the storage of dismantled machines prior to shipment and from here shipments will be made. In the assignment of floor area to these departments, the erecting floor proper is made 16 per cent. of the machine shop floor, as called for by the table, while the shipping room has about 45 per cent. of the area of the erecting shop. The shipping floorage is, in other words, additional to that called for by the data obtained from the old works, which have no such department.

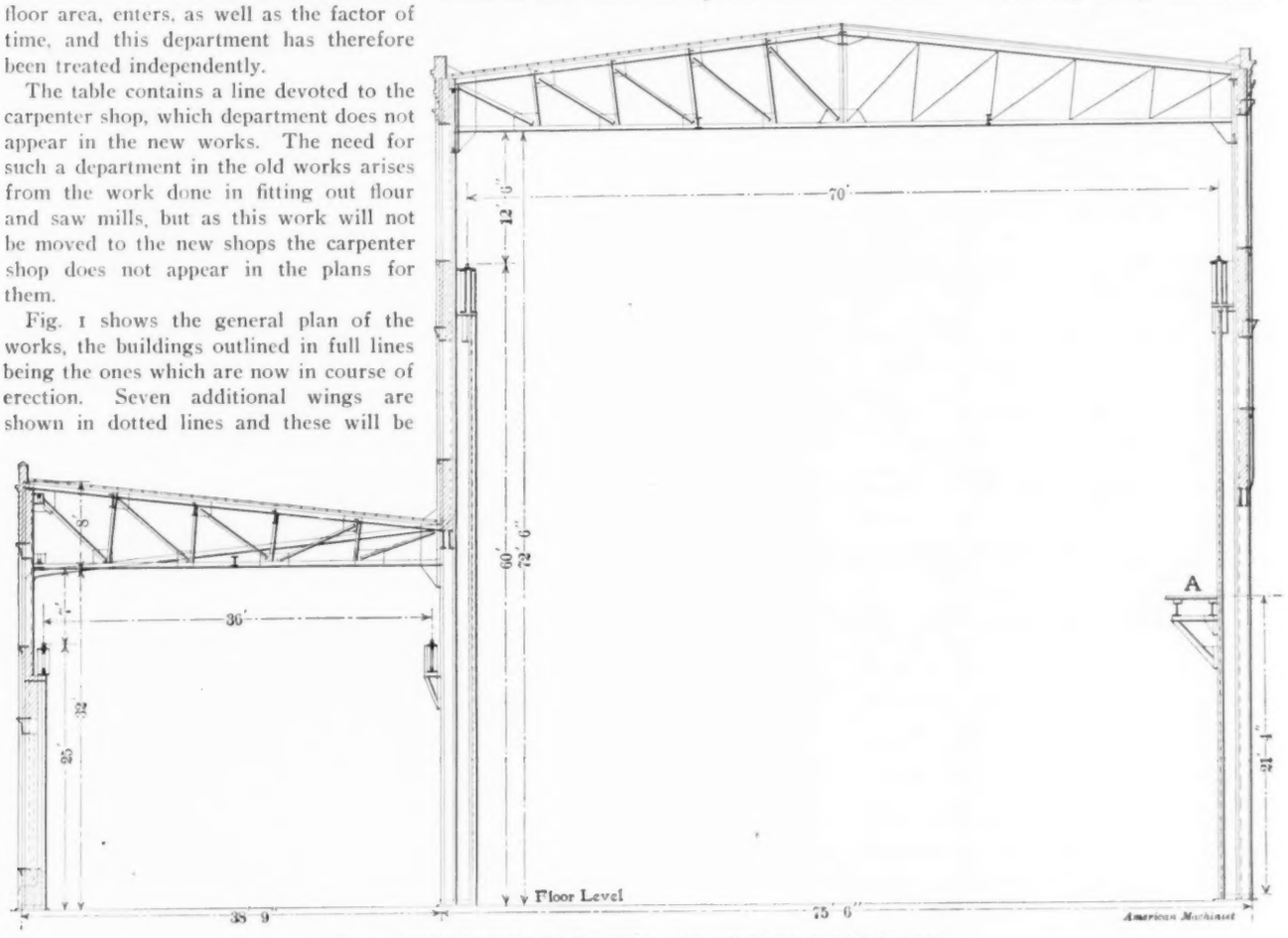


FIG. 2. CROSS-SECTION OF ERECTING AND SHIPPING DEPARTMENTS.

The erecting shop will be seen to be very lofty, being 60 feet under the crane runway rails. This hight will not be maintained in future extensions, which will have but 30 feet under the crane, as the high shop here shown is considered to be ample for any extremely high work which is likely to be required.

The various machine shops will abut on and open into the erecting shop at the right of Fig. 2, and will have a central high portion for heavy work and side portions with galleries for light work. A section of one side portion and half the central portion is shown in Fig. 3. At *A*, Fig. 2, will be seen an elevated walk which connects all the galleries and makes communication between them easy without going to the ground floor.

The length of the machine shops necessitates several cranes in each, and as but one of these could transfer material to the erecting shop were this gallery absent, no attempt is made to pass it with the cranes, the transfers being made by push-cars on tracks *p q r*, Fig. 1.

The pattern shop and storage building is shown in cross-section in Fig. 4, the four-story part at the left being the storage and the one-story part at the right the pattern shop, which will be located on the side of the building facing the foundry in Fig. 1. The storage portion will be thoroughly fireproof, even to the window frames, which will be of iron. The fireproofing of the floor system is shown in Fig. 4. Fire walls will divide it into sections, and openings with self-closing fire doors will give communication between the sections, each of which will have an elevator. The ground floor will have a series of overhead rails with electric traveling hoists suspended from trolleys, by which heavy patterns can be taken from the elevators and run into the pattern shop or through it and deposited on cars which will deliver them to any part of the foundry.

The spaces between the various machine-shop wings will be fitted with overhead traveling cranes, for which one track is

shown in Fig. 3 at the left. The runways for these cranes will be carried across to the foundry, the spaces being intended for storage yards for flasks, castings, etc. A portion of these spaces at the ends near the erecting shop, but in no case adjoining a blacksmith shop, will, however, be roofed over, as indicated in Fig. 1, and be used for shop stores.

The scheme of internal and external communication is shown in Fig. 1. Track *a* connects with the Chicago & Northwestern Railway and track *b* with the Chicago, Milwaukee & St. Paul track with *h* and *i*, the former of which is for delivery and the latter for shipment. Both systems connect at *j* and *k* with tracks *l* and *m*, which are the only tracks connecting the railroads with the interior of the works, and communication can be had in either direction only by passing over the scales at *n*, making it impossible for anything to go into or out of the works without passing the weigh master. Track *o* is for storage of cars. Shipments of completed machinery outwards will be made

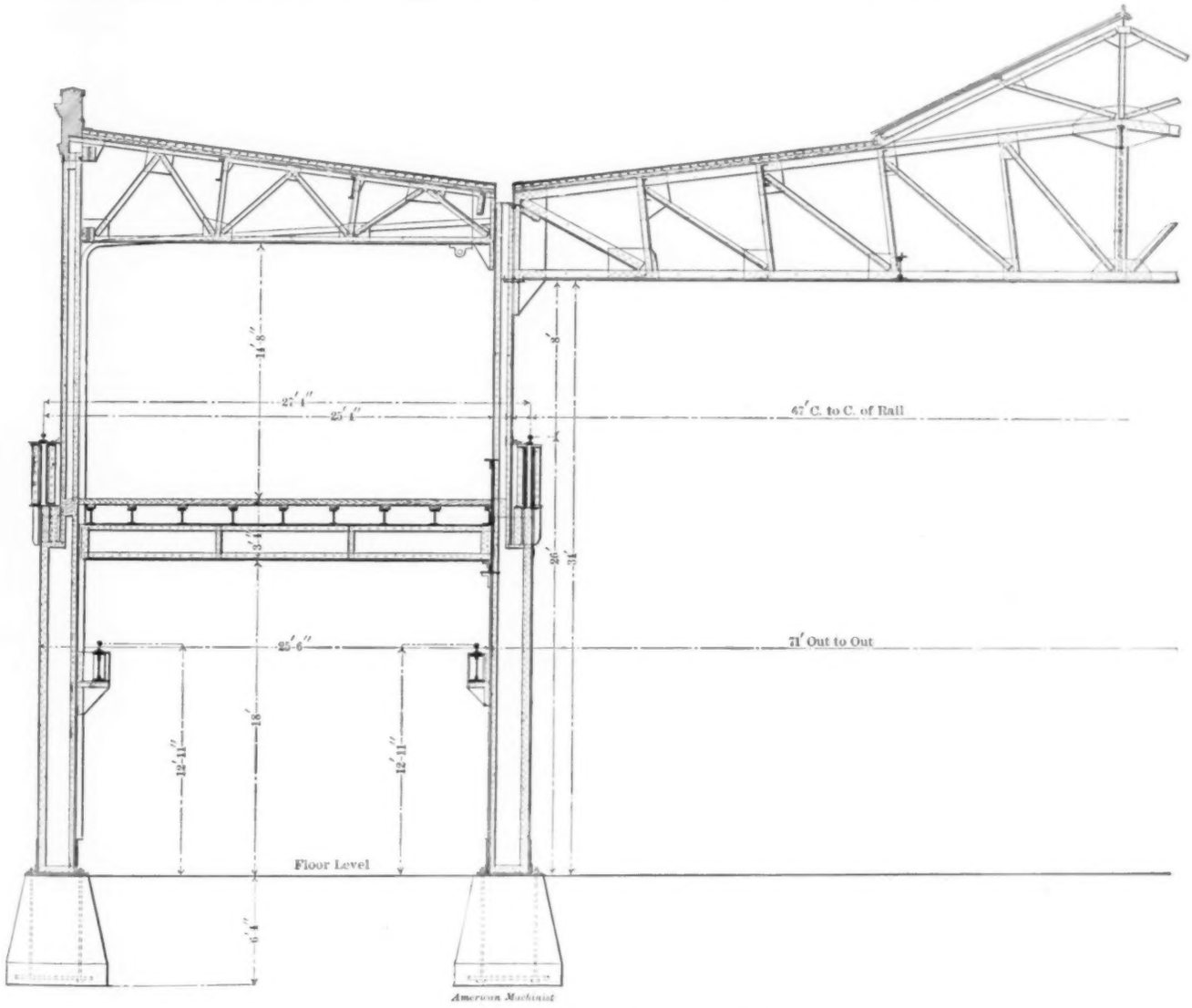


FIG. 3. CROSS-SECTION OF MACHINE SHOPS.

western track at *t*, leaving communication between the two roads free at all times but fencing in the property nevertheless.

Fig. 5 shows a section of the foundry at the cupola charging platform. The elevated track at *a* is the track shown between the foundry and pattern shop in Fig. 1 and nearest the foundry. The space to the right of this track in Fig. 5, and between it and the pattern shop is the pig iron and coke yard. Other sections would show a second floor in space *b*, and slightly below the level of the track which is to be used for sand storage, the sand being delivered through spouts to the main floor below. On this floor at the end near the main office building are also to be the foundry office and chemical laboratory. The level of this floor is shown in Fig. 6.

In this illustration will be seen an inclined track for carrying iron and coke from the foundry yard to the cupola platform, and Fig. 6 is a plan and section of the yard in which the lower portion of the incline appears again. There will be three of these inclines as shown in the plan, the

Chicago, Milwaukee & St. Paul Railroad. At the extreme right of the engraving is a connecting track *c*, by which only is connection between the two roads possible. At *d* is a switch connecting with the Chicago & Northwestern track, which switch connects with two tracks *e* and *f*, to the former of which all loaded cars are to be delivered, while cars loaded for shipment are to be placed by the Allis-Chalmers Company on the latter, from which they will be taken by the railroad company. Similarly a switch at *g* connects over tracks *p*, *q*, *r*, etc., and shipments of pig iron, coal, etc., inward over track *m*, which by the spurs shown connects with all departments. Over these spurs and the connecting track *s* communication is had between pattern shop and storage, foundry, machine shop and blacksmith shop, the deliveries being made under traveling cranes. The line of fencing is inside of tracks *a* and *c*, and with gates crosses over the connection with the Chicago, Milwaukee & St. Paul track at *u* and over the connection with the Chicago & North-

lower ends of which will be served by two pillar cranes as shown. Covering the entire yard, including the pillar cranes and the track shown in Fig. 1 nearest the pattern shop, by which deliveries of iron and coke will be made, is a light traveling crane indicated in Fig. 6. This crane will carry a suspended scale for weighing the iron and coke. A number of hoppers of uniform weight will be included in the

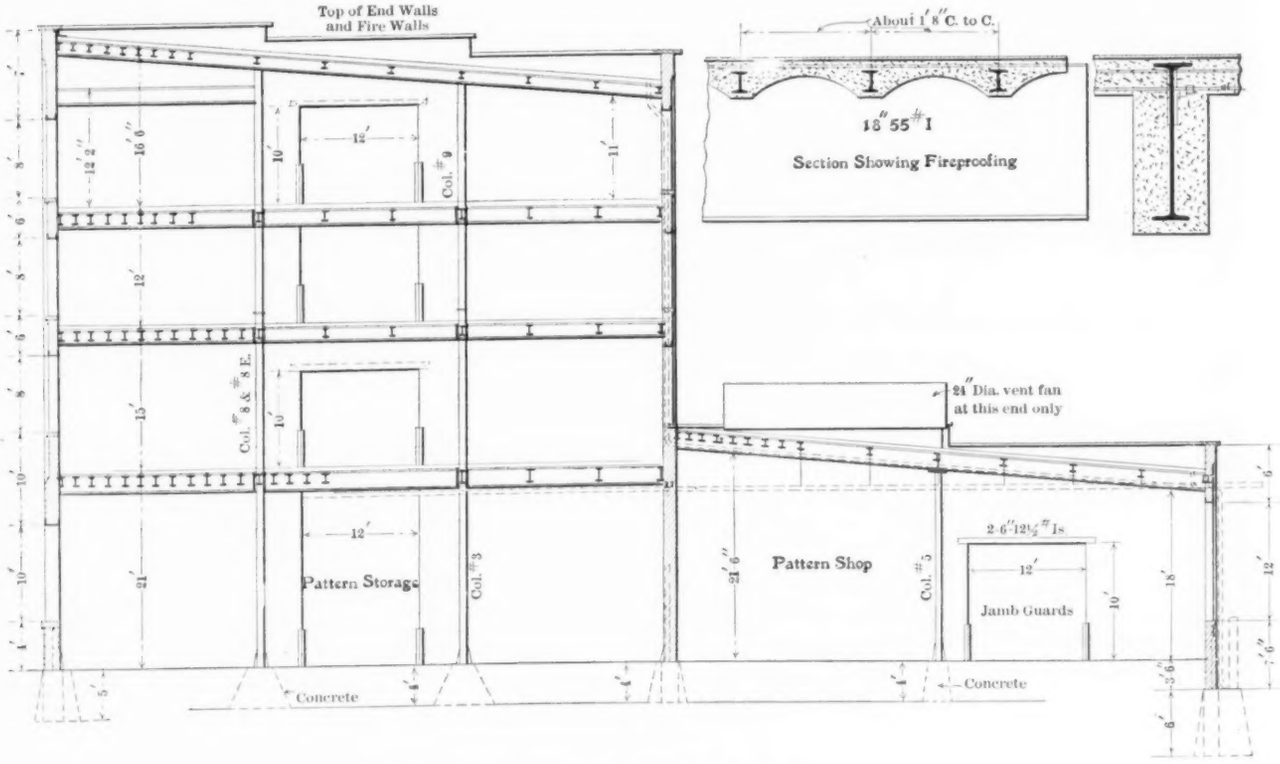


FIG. 4. CROSS-SECTION OF PATTERN SHOP AND STORAGE.

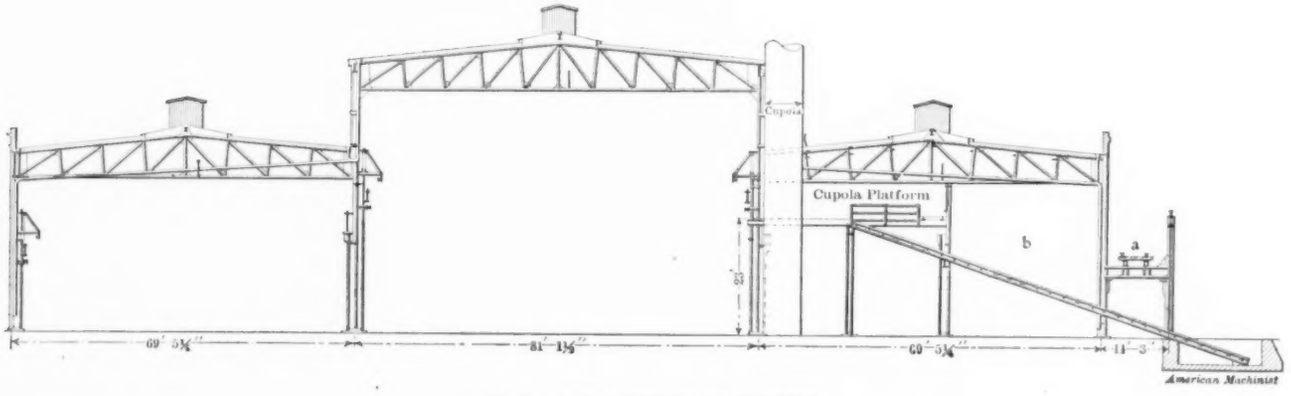


FIG. 5. CROSS-SECTION OF FOUNDRY.

the cupola which, when a heat is on, will be loaded on the incline cars by the pillar cranes and be carried to the charging door of the cupola and be dumped in. It is not expected that this traveling crane will be constantly employed at this work, and it is hence expected to utilize it for working a drop for breaking up heavy scrap castings. Such castings may be located anywhere below the crane which will carry the drop to them and deliver its blows wherever required.

We have thus described the leading features of the general scheme of what is undoubtedly the greatest machine building enterprise now under way, and probably the greatest ever deliberately planned with a view to expected and probable growth. It is, we think, generally understood that this plant is to take the place of the existing Milwaukee works of the Allis-Chalmers Company, and that the equipment of the existing works is to be moved to it. This, however, is an error. Such removal is not contemplated, the new works being entirely an addition to existing facilities. The capacity of the three units now under erection is expected to about equal that of the existing Milwaukee works, and, as we have said, the property acquired and the plans drawn contemplate the utimate extension of these three units to ten.

As the three units comprise but two machine shops, while the ultimate plan will, presumably, comprise seven, the completed works will eventually be about equal to three and a half times the existing works, the combined capacity of old and new being four and a half times the existing works. The magnitude of such plans needs no comment.

equipment. The traveling crane will take one of these hoppers in succession to the piles containing scrap and the various brands of pig iron, a suitable amount of each will be loaded in as determined by the scale. The hopper will then be carried by the traveling crane and deposited within the space covered by the pillar cranes. Other hoppers will be loaded with coke and there will thus accumulate around these cranes properly proportioned charges for

Notes on Crane Design.

BY A. D. WILLIAMS.

The design of crane and crane runway girders is in some ways very similar to bridge girder work. There is an ample supply of information on this last subject and it is equally applicable to crane work, although not specifically intended for that purpose.

The applied loads on a crane girder are somewhat different from those carried by a railroad bridge, their diagram being much simpler. The resulting stresses can be calculated with reasonable accuracy for some, but for others they can be approximated only. The vertical load consists of that due to its weight alone, depending largely on the manner in which the machine and the brake are handled. Impact may double the value of a load, but slack chain on high-speed hoist may treble it.

"Kent's Pocket Book" gives the following table of strains due to slack chain in starting loads:

Dead load	11,500
Gentle start	11,525
3 inches of slack	19,025
6 inches of slack	25,750
9 inches of slack	27,950

The speed of the hoist is not given. Of course due care is assumed to be exercised in handling all machinery of this character, as it is impossible to make it absolutely fool proof. A crane should be designed for use, not for abuse.

The magnitude of horizontal loads to be considered depends on the distance in which the crane can be brought to rest from full speed. This distance can be assumed as 5 feet. It may be much less if the end stops are accidentally run into. The suspended load is never rigidly connected to the trolley, except in bar hoist cranes, so that it swings more or less. This reduces the horizontal effect, or, more exactly, it delays its action slightly. In yard cranes wind pressure must be considered, and can be taken as 30 pounds per square foot of exposed surface.

The bridge motor and brake drum are sometimes located near the center of the span to equalize the torsional deflection in the two segments of the line shaft. Every time the motor is started or reversed, with the crane in motion, it has a tendency to climb around the shaft, that must be resisted by the girder.

Crane runways are often both out of level and not true to gage, conditions which cause racking strains. These strains can also be caused by suddenly starting or stopping the bridge travel with a heavy load close to one end. The end connections of the girders should be designed to resist this, particularly where the trolley runs on the top chord with the fall between the two girders.

Cranes are designed to hoist and move

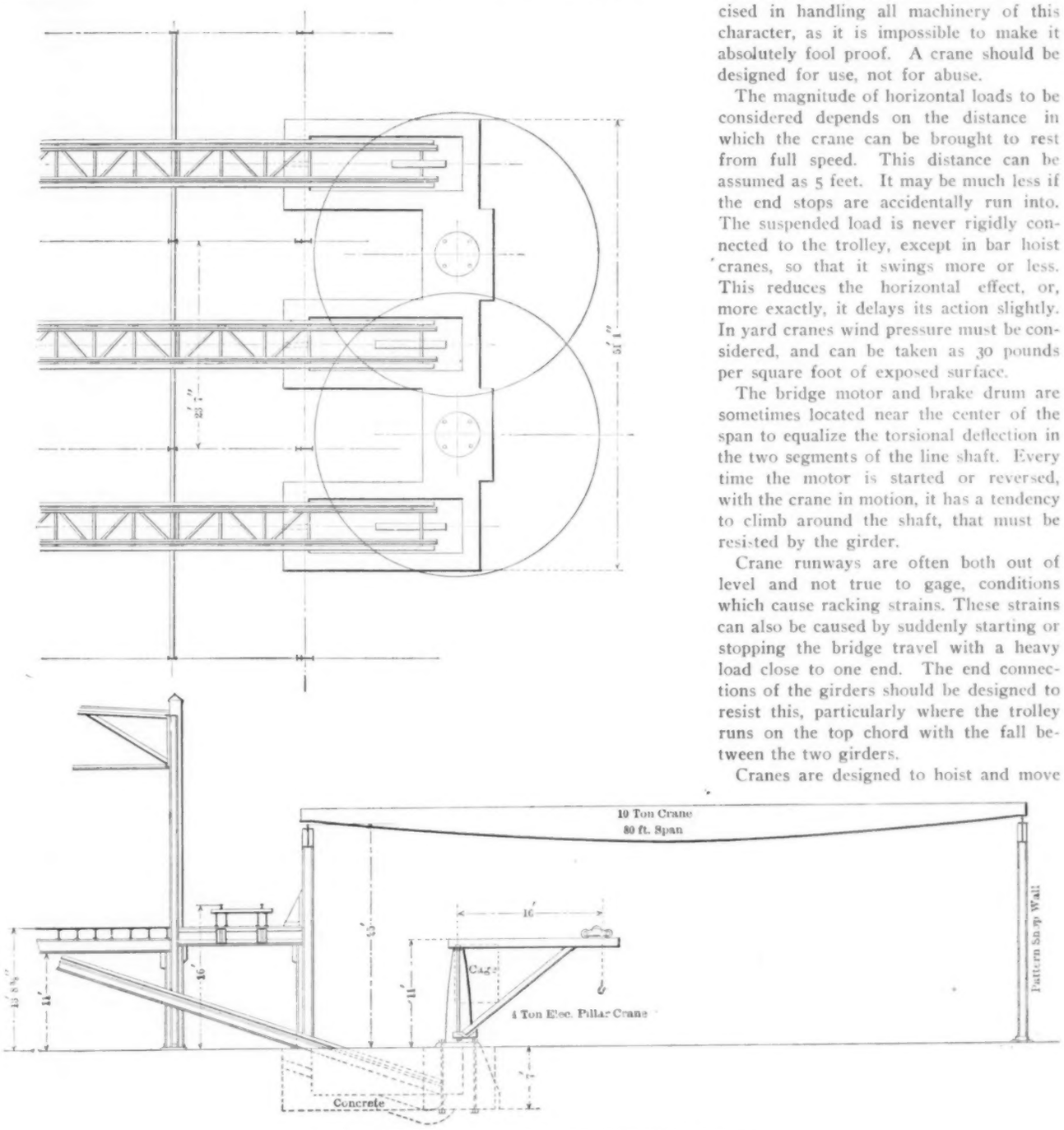


FIG. 6. CUPOLA INCLINES AND PIG IRON YARD CRANES.

loads only, but ingenious people often find them very convenient for other purposes—shifting cars, overloading, etc. Such usage is dangerous, but the instances in which crane girders have failed are comparatively rare.

In calculating the bending moment for

a crane, the weight of the girder and its attachments is often considered as a uniformly distributed load. This is very rarely the case, the girder being generally much deeper at the center than at the ends, and the motor, if at the center, makes a little difference. The difference between the bending moments of these loads as they are situated and that obtained by assuming them as uniformly distributed is small, and to outweigh this, is the fact that the latter method is convenient and saves a great deal of time.

The maximum bending moment with two equal concentrated loads occurs when they are so placed that the center of the span is between them, and one-fourth of the distance separating the loads, from one of them. The formula for this condition of loading is:

$$M = \frac{W}{2l}\left(l - \frac{C}{2}\right)^2$$

for which the notation is given in Fig. 1.

While this formula is the correct one to use, it has the disadvantage of requiring considerable calculating even if logarithms are used. In practice it is not desirable to figure the bending moment much closer than even thousands of inch-pounds. The writer, at page 127, Vol. 23, used a formula which is very convenient, and, although it is not microscopically correct, it will usually come as close to the exact results as is desirable for practical working conditions. It is:

$$M = W a,$$

the notation being given in Fig. 2.

The percentage of error in this formula depends entirely on the ratio $\frac{l}{C}$, being greatest when C is long and l short. Heavy loads necessarily increase the amount, but do not change the percentage unless the ratio is changed. In crane work rapid and fairly accurate results are often much more important than minute accuracy. Numerous other girders with their calculations are available for reference, and their test deflections are an important guide to the designer.

At the best, any formula is exact only in theory. In practice approximate results only are obtained; it is absolutely impossible to build a girder that will actually fit calculated results, although it fulfills all practical requirements.

It is only necessary to allow for impact on that portion of the wheel loads due to the suspended weight. This can be done in two ways—by adding a certain percentage to the load or by reducing the fiber stresses in a similar manner. The amount to be allowed would depend on the speed of hoist and the ratio of the trolley wheel-base to the span. For legitimate usage in cranes, 10 to 20 per cent. additional will usually be an ample allowance for impact, but in certain classes of work a larger allowance would be desirable.

The horizontal bending moment is calculated in the same manner as the vertical, the top chord being considered as a horizontal girder to resist it.

The combined stress due to the lateral and vertical stresses can be found as follows:

$$P = \sqrt{p^2 + p_1^2}$$

in which

P = combined stress, pounds per square inch;

p = vertical stress, pounds per square inch;

p_1 = lateral stress, pounds per square inch.

The horizontal bending moment can be neglected if it is less than 20 per cent. of the vertical, but if it exceeds that figure the section must be increased until the total stress does not exceed the vertical stress by more than 20 per cent.

The top chord of a girder acts as a column whose length is the span. The allowable fiber stress in compression is governed by the ratio between its length and the radius of gyration about its vertical axis, as, being supported by the web plate, it can only fail horizontally. In railroad bridges the ratio of $\frac{l}{r}$ is limited to 100 except in wind bracing, where it can be 120. In crane work even higher ratios have been

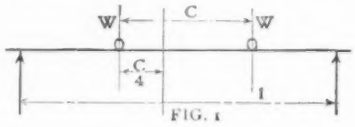


FIG. 1

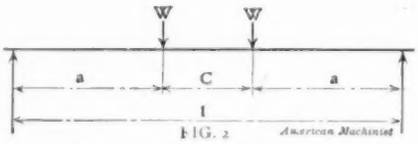


FIG. 2 American Machinist

LOADING OF CRANE GIRDERS.

used occasionally, but it is much better practice to set the limit at 100. The permissible working stress per square inch in compression can be found by several methods.

The Pencoyd formula for medium steel (a modification of Gordon's formula) is:

$$p = \frac{17{,}000}{1 + \frac{l^2}{11{,}000\, r^2}}$$

in which

p = permissible working stress in pounds per square inch,

l = length of span in inches.

r = radius of gyration of section in inches.

This gives 8,900 pounds per square inch when $\frac{l}{r} = 100$.

In Cooper's specifications the following limits are given for medium steel compression members:

$$p = 10{,}000 - 45\,\frac{l}{r} \text{ for live loads,}$$

$$p = 20{,}000 - 90\,\frac{l}{r} \text{ for dead loads.}$$

This is cut down in swing bridges and movable structures where the dead load unit stresses must not exceed three-quarters of those allowed in stationary structures.

There is some diversity of practice in calculating the strength of beams. The moment of inertia method is used by some; in this the total section of the girder is figured as resisting the longitudinal strains. Others consider the chords as resisting the longitudinal and the web as resisting the vertical strains. The effective depth of the web plate is the distance between the centers of the rivet holes. The chords are by some limited to the area of the cover plates and flange angles, others include one-sixth of the web plate. The writer prefers to include only that portion of the web plate lying between the vertical legs of the flange angles. The effective depth of the girder to the distance between the centers of gravity of the upper and lower chords. In calculating the strength of the lower flange or tension member the net area is to be considered, either through a traverse line of rivet holes or a diagonal line of rivet holes where the net section does not exceed by 30 per cent. that along the traverse line. In deducting rivet holes they are taken as ⅛ inch larger than the rivet. Field rivets should be avoided. Where necessary their efficiency should be taken as 20 per cent. less than shop-driven rivets. An allowance should be made when field rivets occur in compression members. The area of a rivet is its area before driving.

The maximum shear occurs immediately over the edge of the abutment. In a crane this is the edge of the track wheel beam. Heavy stiffener angles can be placed at this point in box girders and utilized to carry the trolley wires. In box girders one web is usually considered as taking the shear due to the wheel load nearest the end plus the dead load shear due to one-quarter the weight of the girder and that due to cage and bridge mechanism. The bridge rail distributes the vertical strain due to the wheel load over a certain amount of space which should not be taken as more than two feet each side of the wheel. The web-plate stresses can be found as follows:

Let

W = trolley wheel load,

b = distance over which rail spreads wheel load in inches, not over 24 inches each side of wheel;

p_1 = strain transmitted to web by flange $= \frac{W}{b}$.

p_2 = vertical shear in pounds per square inch $= \frac{\text{total shear}}{d\,t}$.

d = depth of web plate center to center of rivets in inches,

t = thickness of web plates in inches,

p = web stress per square inch permissible,

p_3 = web stress per square inch.

Then

$$p = \frac{12{,}000}{1 + \frac{d^2}{1{,}500\ t^2}} \quad \text{(Gordon's formula modified)}$$

and

$$p_3 = \sqrt{p_1^2 + p_2^2}.$$

p_3 must not exceed p.

No web plate should be less than ¼ inch in thickness.

As before noted, heavy stiffener angles can be used at this point in box girders, or else the web should be heavily reinforced by an additional plate, care being taken to work in enough rivets. In plate girders the stiffeners should be placed at a distance apart equal to the depth of the girder, or at a maximum spacing of 5 feet. Additional stiffeners should be placed where concentrated loads occur. These stiffeners should be composed of angles riveted to the web plate fitting tightly between the top and bottom flange angles, of such a size and number that they are able to carry the reactions at that point. A sufficient number of rivets should be used in each pair of stiffeners to transmit the shear to the web.

The rivet spacing between the flanges and the web is proportional by the shear at each point, close spacing being required at the ends. The usual limits of rivet pitch are from 2½ to 6 inches and variation should be made by quarter or half inches, so as to get an even number of spaces in each panel.

There are three types of crane girders in use—the single webbed plate girder, the box or double webbed plate girder and the lattice girder. These have been modified and changed in numerous ways to suit circumstances or the preference of the designer.

The single webbed plate girder was an early favorite. It can be easily constructed, and is open to inspection and repainting on all sides. Lateral stiffness, however, calls for a heavy top chord. The bottom chord has a tendency to vibrate under the influence of sudden starts and stops. The weight of the line shaft and motor forms an eccentric load tending to twist the girder, particularly if it is shallow. An attempt was made to overcome these troubles by placing the trolley between the two girders and running it upon the bottom chord. This necessitated the use of heavy "C" clamps over the top to prevent the lower chords from spreading. This interfered with the accessibility of the trolley and introduced considerable dead weight, but it permitted the girders being braced to each other in such a manner that they formed in effect a box girder, with a latticed top, the bottom cover plate being omitted. The lateral strength of this construction could be made as high as desired. One advantage was gained by this method. The girders being rigidly tied together, the end connection was rigid, and this tended to keep the structure square.

Plate girders with auxiliary lattice girders have also been used. In some of these the top cover plate was extended over the lattice work, making in effect two plate girders at right angles with their outer and lower chords braced together. With this construction there is no difficulty in getting any required amount of lateral strength. The lattice auxiliary offers excellent points of attachment for motors, line shaft, brackets, etc. The only disadvantage of the "hay rack" girder is its complicated construction. It, however, offers ample opportunity for rigid end connections, and, if properly designed and built, is one of the best forms of crane girder.

The plain plate girder is only available for short span cranes.

The box or double webbed plate girder is extensively used, and is well adapted to crane purposes. It is very simple in construction and neat in appearance. The stiffeners can be placed between the web plates. If angles are used, their projecting flanges can be laced together. In most cases stiffeners can be avoided altogether by using bolts or long rivets and distance pieces to tie the web plates. The top cover plate can be supported, if necessary, by riveting in bridging pieces between the webs. The difficulty of internal inspection is one objection to this form of girder.

Lattice girders are suitable for yard cranes and long spans. Through and deck spans are used. The through girders carry the trolley upon their lower chord and are braced together over it. Deck girders, when used, are usually built in the form of a latticed box to gain the necessary lateral stiffness. All parts are open to inspection. The leading disadvantage of lattice girders is their complicated construction.

Universal Bench Vise.

The Jacobson Machine Manufacturing Company, of Warren, Pa., is making a bench vise which has some unusual features. In the half-tone, Fig. 1, the vise is shown with the jaws in a horizontal position, and in Fig. 2 with the jaws vertical. The base, which is fastened to the bench in the usual manner, is made with a large central post; the vise body is bored out from the bottom and also from the sides, and can be placed on the post in either of the positions shown, or it can be turned directly over from the position in Fig. 2

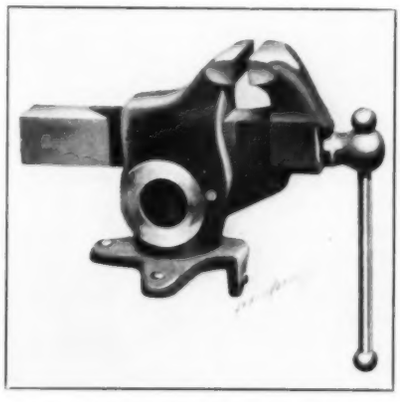


FIG. 1. UNIVERSAL BENCH VISE.

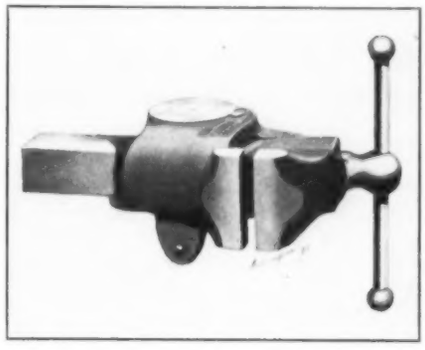


FIG. 2. UNIVERSAL BENCH VISE.

and placed with the other side up. The vise can be turned around on the post and clamped at any desired point, the screwing up of the jaws on the work operating the clamping device.

The clamping piece is shown in Fig. 3; it fits in a slot in the vise body and is hung on a pin, shown in the half-tones, at the right of the post. The top of the piece is drilled to allow the screw to pass through freely, and an opening is provided

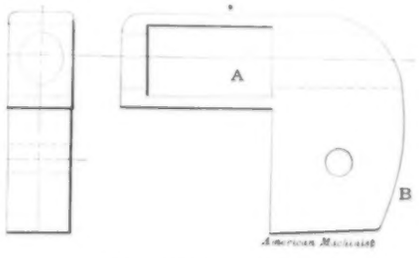


FIG. 3. CLAMP FOR VISE.

at *A* to admit the nut. As the screw forces the movable jaw against the work, the nut draws the top of the clamp back, pressing the surface *B* against the post and holding the vise fast.

In addition to this universal vise the company makes a plain swivel vise, which is also fitted with a special clamping device.

We have always insisted that the advertiser has no claims on our reading columns for space and that the place for him to tell his story is in that part of the paper set apart for him. The subscriber has a right to demand that the reading columns of the paper he pays for shall be filled with something more substantial than personal puffs and parts from catalogs. It has at times been difficult for us to make an advertiser realize that we could not describe his personal affairs in our editorial columns without injuring him as well as the paper. The uniform support received from the trade shows that our position in this matter is approved.—*The Foundry.*

Letters From Practical Men.

An Example of How Not to Make Drawings.

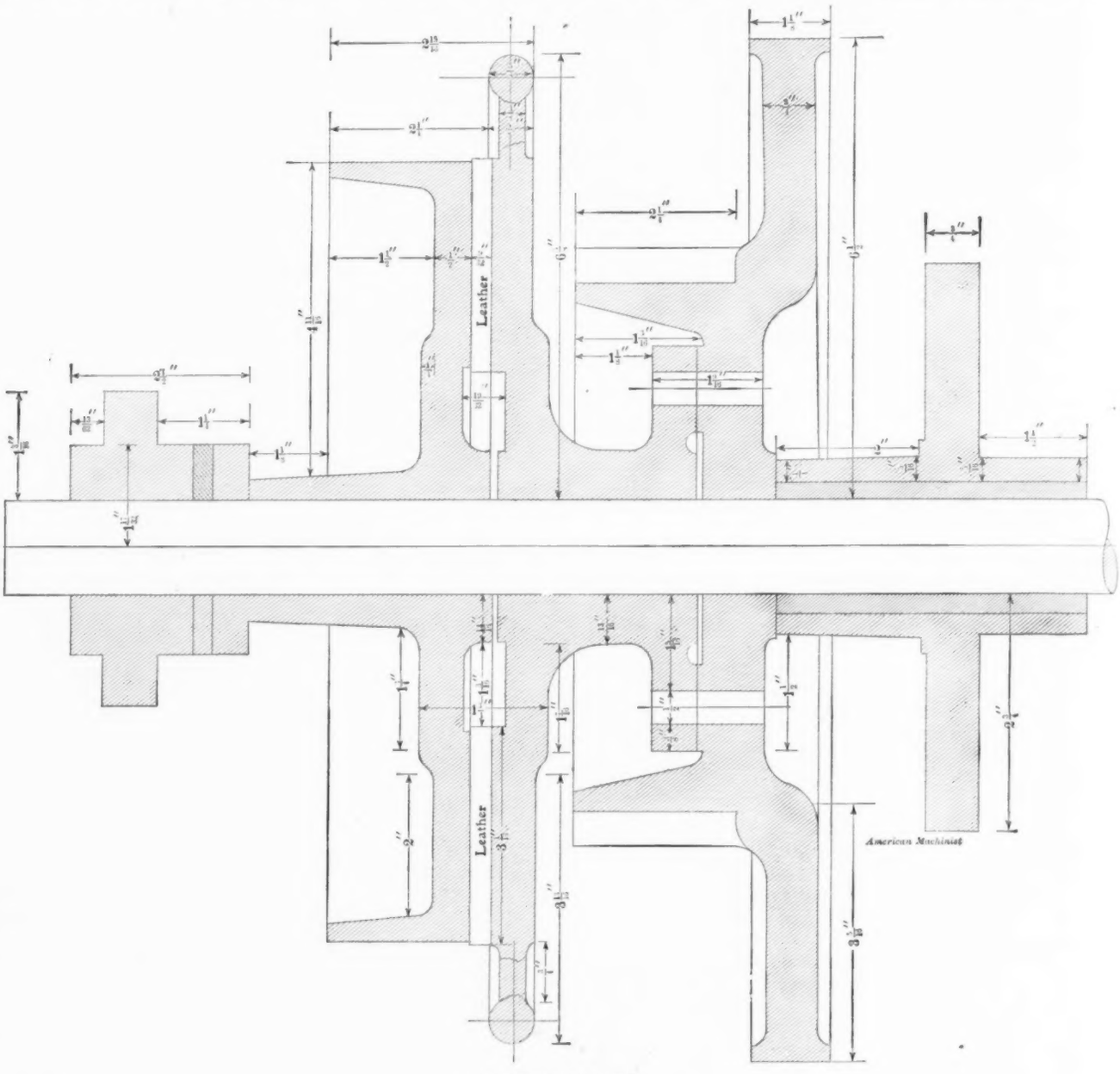
Editor American Machinist:

When a new draftsman comes into an office there is generally a deal of speculation as to his abilities on the part of his fellows. Sometimes this dubiety will extend even to the chief, especially when he has not had a hand in the selection, and he is always anxious to place the newcomer as soon as possible, and find out just what he *cannot* be trusted to do. This was the case some time ago with myself, in an iron works situated in a country town within easy reach of a large city where our head office was located. We were looking everywhere for draftsmen to meet a rush of contract work, and, of course, as usually happens at such a time, it seemed very difficult to get them, and harder still to keep them in a country town with a large city so close by. We were pleased, therefore, when the manager rang up one morning and told us that he had got a young man who was coming out on the first train and was likely to stay. When we asked for some particulars as to his previous experience, however, the manager seemed a little chary of information and said he had been for some years in the office of a friend. He added that he was a nice, modest, young man.

When he came he didn't seem to be a nice, modest person at all, and it was hard to tell him even the things about our office methods which he could not, for obvious reasons, have known. It was too late to start him that day, but he was invited to go out into the foundry and see them pouring some rather nice work, before he returned to the hotel.

The blank expression on his face and his hesitating inquiry as to which was the foundry and what pouring was, rather "fazed me," but the last rush of the day doesn't allow time for questions. Over our pipes that night I mentioned the joke to the superintendent, but his incredulity made me doubt whether I had heard aright.

The next morning I started my man on a tracing of a friction for a textile machine; which friction, as will be seen by the accompanying section, was made up (beginning at the left-hand side) of the clutch collar, a fiber washer, the driving pulley, which bears against a friction leather fastened to a hand-wheel, this being in turn bolted to a combined gear and brake wheel. The shaft bearing is bushed with yellow metal, and is bolted to the side frame of the machine. The drawing shows exactly the result which his labors produced, and it was a result that took



A HOPELESS CASE.

my breath away. Whatever doubts I had were resolved into certainties. He had really had two years' experience—as I found on questioning him—in the office of a relative who had something to do with patents. He clung to this two years pathetically, and returned to it again and again. He hadn't thought there was any difference between the work of a regular drawing office and his former employment, and couldn't see that he had any special nerve in setting up to be a draftsman. This last was in reply to the "super's" rather caustic catechism.

He went away by the night express, and next day called in at our city office and complained that he had been badly treated. With our reply to the manager we sent a copy of the tracing. He thought it was in itself a sufficient answer. That this is so may be verified by looking carefully over the dimensioning of this supposed working drawing. The manifest humor of it will appear to most people who are accustomed to handling or making drawings. Take the outside dimensions, for instance—scaled from the rim to the edge of the bore! or the dimensions from one casting to the other! or the figures for the centers! or the sectioning! I leave it to my readers whether it isn't in the front rank of "the worst yet."

H.

[This sample could serve as the text for a sermon on the difference between drawing and drawing. It is neatly executed, and shows that the maker had had considerable practice in making lines which he thought were all that are needed in making drawings. It shows, of course, a hopeless failure to comprehend shop methods or the requirements in shop drawings. The material of the leather washer was indicated in the original by brush or crayon shading. As this cannot be reproduced, we have indicated the material by the word Leather.—Ed.]

Eccentric Arbors—Locating Jig Buttons—Graduating Tool.

Editor American Machinist:

At page 1359, Vol. 24 there was an article describing a method for centering

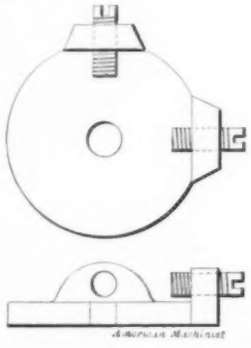


FIG. 1. FOR BUTTON LOCATING DEVICE.

eccentric arbors. While the method as given is theoretically correct for getting the centers in line both ways, it is rather difficult to get the right eccentricity. A much easier way, and one which gives excellent results, is to do the job in a milling machine. Place the stock in the vise and center one end, using a combination center

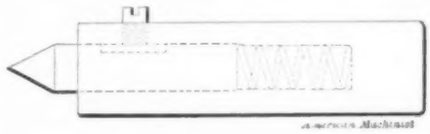


FIG. 2. GRADUATING TOOL.

drill in the spindle chuck. Then raise the table, using graduations on elevating screw, and put in the eccentric center. Swing the vise half round and put in the other eccentric center, and drop to original position for the last one. The table will have to be moved longitudinally to bring the last two centers in line with the first two. If carefully done, this method will give results within .001 inch, and in about one-fifth the time required to do the job in a lathe.

Everyone who has ever set a "button" on a jig for location, knows that it takes lots of patience to get it just right from two sides of the jig. Make a nice flat washer, as shown in Fig. 1, about ⅛ inch thick, a trifle larger than the button, with a hole to fit the screw used to hold the button in position. Have two flat spots on edge at right angles, solder on two ears and fit a screw with a square end in each ear. By placing this under the button and having the ears square with sides of jig, with the button screw tightened a trifle, the button can be screwed to the right position very quickly and easily. Then tighten the button screw firmly. The ears and screws should be as small as is practicable, so as not to interfere with the indicator.

A handy tool for graduating a dial or similar work in a milling machine is shown in Fig. 2. It is what might be termed a spring pointer, the principal advantage being that the point is less liable to break. It is made of square stock and fitted with round pointer.

C. N. HARGRAVES.

Shade Lines on Drawings.

Editor American Machinist:

In regard to shade lines on drawings, they, like most other things, have a field of usefulness. On most shop drawings they are not useful—that is, they add nothing to the clearness of the detail, and therefore should be omitted, as a waste of time. Occasionally shade lines will be found to add a great deal to the ease with which a drawing is read. I use them or not, according to the case in hand. For instance, in getting out a large and complicated foundation lately, both shade lines and conventional sectioning were employed. There were tunnels and shafts to give access to the bolts. But on shop drawings I find very few occasions to use them, and in my experience have found only a few places where they were used.

In making a clear drawing, the full lines should be somewhat heavier than the dotted ones, which, in turn, should be heavier than the witness and dimension lines. Witness lines should not run into and continue the lines of the drawing.

A. D. WILLIAMS.

A Help in Copying With a Copying Pencil.

Editor American Machinist:

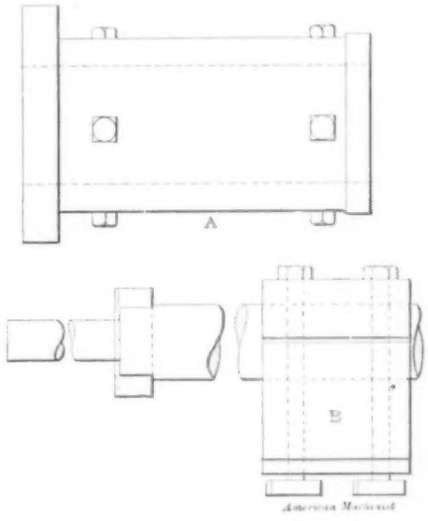
It sometimes happens that a draftsman has to use a copying pencil on bills of material, freehand sketches, etc. I find it quite a help in getting good, clear copies if I use a sheet of tin under the paper while sketching or making out the bill. The tin being hard, keeps the pencil from grooving the paper. Two or three more copies may be taken this way than if the backing for the paper had not been used.

AHORA.

Boring Bushings in the Lathe.

Editor American Machinist:

Having a lot of long bushings to bore in the lathe, the following method was adopted with very satisfactory results: The bushings were held by two sets of three ¾-inch set-screws in a flanged casting *A* faced and bolted to the face-plate. The outer end was turned to receive the steady-rest. This was quicker than using the chuck because it was not necessary to turn a spot on the bushing for the steady-



BORING BUSHINGS IN THE LATHE.

rest. The boring bar was clamped in the block *B*, which was bored in position. The bar was turned down for a distance somewhat greater than the length of the bushings to be bored, and fitted a bushing in the hollow spindle. This made a very stiff arrangement and a modern feed could be used. There was nothing special about the roughing cutter, but for finishing the cutter described at page 1011, Vol. 24, was used, this cutter making a good, true hole.

V. W. X.

Making Drawings and Patterns for Screw Propellers.

Editor American Machinist:

It was with much interest that I read the article, "Making Drawings and Patterns for Screw Propellers," by Old Bob, at page 530.

Of that "colossal nerve" which he ascribes to "back-numbered marine draftsmen," Old Bob certainly has his share. The methods which he says are modern, we will all agree, were modern once; but in these days when so many marine engineers are striving for honors, his methods of laying out a screw propeller would not give the patternmaker sufficient information to turn out a pattern from which a propeller could be cast which would be exactly as the designer intended it.

As to his statement that the dimensions of the blade at the top of the hub fillet and at its greatest width are sufficient to make the pattern of the blade, I wish to say it is a mistake, as these dimensions will not determine the shape or size of the blade by a good deal. We might make on a piece of paper these four points determined by his dimension lines, and pass through them any number of outlines, all different in shape and area; so that if a designer laid out a screw propeller drawing after Old Bob's method, unless he spent a great deal of time in the pattern shop, or unless the patternmaker was a marine engineer (which is not very often the case), he would not get the kind of propeller which would give him the best results.

It is true that the draftsman can exceed common sense in unnecessary projections and dimensions; yet sometimes a little of this unnecessary work will reveal a mistake to a designer who thought himself infallible, and I do not recall a single complaint, from a patternmaker, of having too many views or dimensions from which to work. If Old Bob had to design a propeller whose blades had to pass through a given space, as is sometimes the case, he would find that this projection of views would be quite useful.

In another method Old Bob has guessed right the first time as to the reason for giving the pitch angles and cross-sections at different radii. Another reason for giving these is that the patternmaker may cut thin boards to correspond to these pitch angles, and mount them on a board at their respective radii and bent to these radii to be used as a templet. The patternmaker will then be ready to glue up his segments, if he has not already done so. When the casting arrives, this same templet will be useful in finishing and polishing the blades as they were designed; and after the working face has been trued up, the propeller may be made to balance properly by taking the surplus metal from the backs of the blades.

The method recommended by Old Bob I do not like, as it is impossible to glue up the segments so that they will be mathematically correct, and wood *will* shrink and warp in gluing, therefore this method would not be as nearly accurate as is to be desired in strictly high-class modern work.

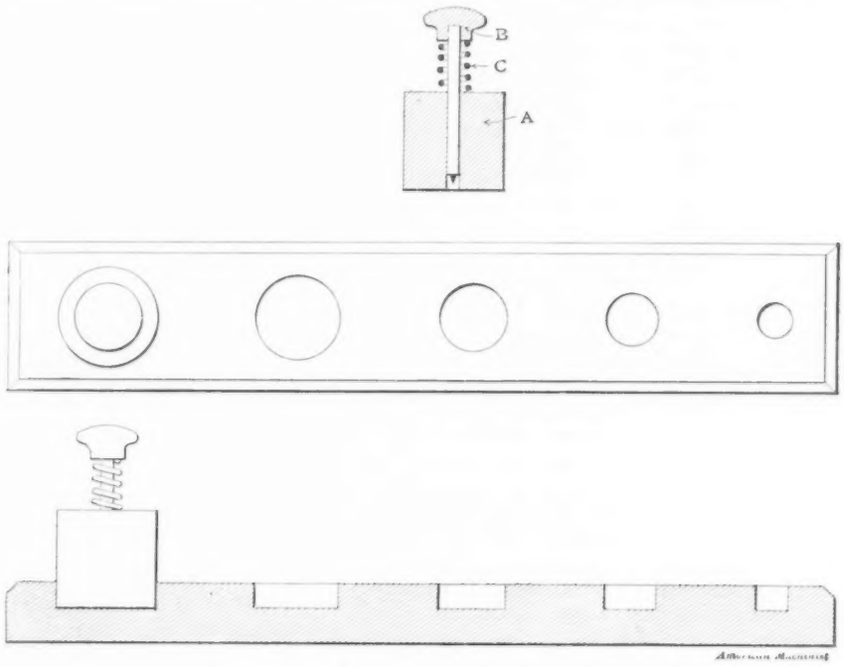
Old Bob takes more pains in gluing up his segments than is necessary. It is true that a piece of work well begun is half done, but I believe that gluing up the segments is of less importance than being sure that the working face is correct when the pattern is finished. If he takes it for granted that when his glue joints show, his blade is finished, then he is not very particular as to what kind of a propeller he is going to have. He speaks of inexperienced patternmakers who try to make a perfectly balanced propeller by trimming the pattern. Now, I never saw a propeller pattern which needed more than one blade attached to the hub; and the patternmaker who made three and four blades to his patterns must have been inexperienced indeed.

In the office of a marine engineer and naval architect in New York city, who has designed and built the fastest boats in the world, and in whose employ I was several years ago (I wonder if it is the same person of whom Old Bob speaks) the segments were delivered glued up; then on a bright Sunday morning Mr. —— would go to his office, and, having hung his trousers on a nail on the wall (this being a part of his method), would proceed to whittle and shave his pattern until it suited his fancy. He made a few sections and templets on paper, but no regular drawing, and when he dies his secret method will, I suppose, die with him. On the following Monday morning all the drawings and everything else in the office had a coating of sandpaper dust, and the air about the work bench had a peculiar bluish tint.

In making a drawing for a propeller to be swept up in loam, it is quite necessary to give the pitch angle at some point outside the largest diameter of the propeller for the pitch board, and it is necessary to give several cross-sections and the developed blade with sufficient dimensions to determine its shape.

Now, in concluding, I would say that I do not pretend to know all there is to be known about laying out screw propellers, and I will admit that what I don't know about it would fill a bigger book than "Barnaby" or "Bury" or "Taylor" and lots of others; but I am willing and anxious to learn a great deal more on the subject and hope that Old Bob will have no hard feeling toward me for expressing my opinion.

YOUNG BOB.



A DRAFTSMAN'S TOOL FOR FINDING CENTERS OF FILLETS AND CORNERS.

Drawing Room Practice.

Editor American Machinist:

I suppose every draftsman has some home-made tools and rides a hobby on them. The illustration shows two views of one which I have found a time-saver where many round corners are required on a machine. The tool consists of the body *A*, in which a hole is drilled to fit a compass needle point. The button *B* is driven on the upper end of the needle point, and a coiled spring *C* is placed between the body *A* and the button *B* to keep the needle point off the paper when not in use. The lower part of the illustration shows a wooden base for holding a set from ¼ to ¾ inch diameter, advancing by eighths.

The method of using is as follows: The body *A* is held by the thumb and middle

finger and is placed tangent to the lines to be connected by the arc of a circle—generally, of course, a quadrant; then the needle point is forced into the paper by the forefinger, locating the required center. After locating the centers for all corners the arcs are drawn in the usual manner. SPARTAN.

The Foundry Trade School.

Editor American Machinist:

I have been reading with a great deal of interest the ideas and comments on the proposed foundry trade school. It seems very remarkable to me the wide difference in the opinions of some of those who have contributed to your paper on this very important subject. I see nothing to cause me to think that a trade school could not be run on a paying basis, despite the adverse opinions of some of your best contributors, notably Tecumseh Swift. An ideal school to my mind would be one with a complete drawing, pattern, foundry and machine department, each run under separate heads though under the same executive. The students, as we will call them for want of a clearer name, would be first-class workmen in their respective trades who desire to have a technical education. There would also be the technical man who desired the practical side of his trade, or profession if it is more agreeable to some.

For example, we will consider two men, one each of those mentioned above. They were poor boys; one has had to go to work at an early age to help support a family. He is at an age now where he can feel the want of a better education, but cannot afford to stop work in order to get it. The other is a young man who has just been allowed enough to get a good education and wants to go into a mechanical profession, but is not willing, or rather thinks it unreasonable, that he should have to go in and serve as much time in a shop as a boy who has practically no education and possibly no taste for the work. They are two men who could be of the utmost value to each other, each spending half of his time working for the market and at the same time teaching the other fellow what he wants to learn, and *vice versa*. I am taking for granted that the school is well equipped. I claim that it would pay its own way and produce work of the highest order, and at the same time turn out men who would always be in demand and become, after a little while spent in a shop, ideal foremen, managers or union leaders.

Am I using my imagination too much? I know there are men of both the kinds I have mentioned. I know there are mechanical engineers who would for no compensation help in the plans of such a school and who would from time to time give free lectures or advice, as opportunity offered. There would not be required many men with big salaries, or any more than in any kind of business. There would be no dividends to be paid; every man would be there because he was a first-class man and wanted to make it pay for his own benefit, instead of filling the pocket of a company who possibly did not appreciate his efforts. There would be no rent, no debts to pay interest on, and every man would be a stockholder for the time being. Could there be any better conditions under which a school or business could be run? I think not.

I hope this is only the beginning of this movement and that the time is close at hand when men with means and influence will take hold of it in a business way. Would it not pay them or the government to invest a little money in this direction? Hoping to see much more on this subject by your correspondents, I await with interest their views. J. O. B.

Glass Covered Desks—Roller Bearings.

Editor American Machinist:

The glass-covered desk suggested by S. H. M., at page 561, is a good idea, but an old one. It is deserving of the attention of those who appreciate handy helps for office work. I have had a piece of beveled-edge mirror glass on my desk for three years, on the bottom side of which I have pasted price lists, formulas and useful tables which I have collected, also standard data for machines which we build. These are, of course, pasted by the corners only, face upward, on the bottom side of the glass. It can readily be seen that we can see the information desired at a glance without looking through a dozen books and catalogs, as is usually the case.

The beveled edge prevents the catching or sticking of articles or hands upon the edge of the glass, a point which will be appreciated after using it. We now have several of these glass-covered desks, and we find them great time-savers.

I am looking for all the information I can find about roller bearings. Our own experience with them, so far, has been very unsatisfactory, and we cannot see any great advantage gained by their use instead of good self-oiling babbitted bearings. Our work ranges from heavy and rough machinery down to fine accurate machines, giving us ample opportunity to test them. Following are a few of our experiences:

Three years ago we bid on a traveling crane of 25 tons capacity for a warehouse. We had previously built two cranes of the same capacity for the same party, and naturally expected to receive the order. We lost it, however, and the other day we received word from our old friend asking us to send out a man to examine their new traveler. We sent our man out, expecting to find some small trouble which could easily be remedied, but he returned saying that the trolley had roller bearings which had been completely crushed. We were rather surprised at this, for we knew that the builders were makers of cranes of a high standard of workmanship, and we were sure that they used only the best of material for everything. Upon examining the roller bearings we found that they had, from some cause, failed to do their work properly, the rollers being crushed into pieces. The bearings were for a 3 7-16 inch shaft, and the rollers were of the hollow wound type, of about ½ inch diameter. In each bearing we found but two whole rollers. The rest were in pieces and had cut the shafts very badly—in fact we had to furnish new ones. If these bearings had not been oiled we would have thought that this would have caused the destruction, but they were simply swimming in oil. To make a long story short, we cast aside the roller bearings and substituted our self-oiling babbitted box, which had given good satisfaction on the other cranes.

We have, in our time, done a great amount of work for the mines in the South, and are doing it yet. We have furnished them at odd times at least twenty rock cars having a capacity of about 1,500 pounds. These cars had our special self-oiling babbitted bearings, which gave great satisfaction, but the superintendent, a man of up-to-date ideas, decided that the next lot of cars should have roller bearings.

One characteristic of the Southern negro is to hunt for the easiest way to do his work, and he has his eyes set on the easiest running cars, for they are pushed by hand. The superintendent thought it would be a fair test to put the new cars among the old ones, and not notify the negroes that these were expected to run a little easier than the others, but wait and see which cars they would make a grab for.

We waited for months to hear from him regarding the cars, but he said nothing about them in his letters, and we came to the conclusion that after giving them a fair chance to be eased up, he saw none of the men especially anxious to get them. This conclusion was verified a year afterward by his ordering five more cars without roller bearings, for he stated that after seriously considering the matter he could see no advantage to be obtained by their use.

I would like to have the opinion of the readers of the AMERICAN MACHINIST on this subject and get their good, practical ideas. We will all admit that the tables of efficiency shown by all ball bearing salesmen are samples of what can be done theoretically, but we are after the practical side of the question just now.

I await with interest the ideas of your readers on this subject. S. P. Y.

It is announced that Herr Krupp has brought to perfection a gun the projectile from which will pierce the heaviest armor plate he makes, and he has promised the Kaiser that only Germany shall use it.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 448,250 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
A New 10-inch Toolmakers' Lathe	833
Echoes from the Oil Country	834
The Krupp Works and the Dusseldorf Exhibition	836
Portable Double Spindle Drilling Machine	840
The General Scheme of the New Milwaukee Plant of the Allis-Chalmers Company	840
Notes on Crane Design	845
Universal Bench Vise	847
Letters from Practical Men: An Example of How Not to Make Drawings .... Eccentric Arbors—Locating Jig Buttons—Graduating Tool—Shade Lines on Drawings ....A Help in Copying with a Copying Pencil....Boring Bushings in the Lathe....Making Drawings and Patterns for Screw Propellers....Drawing Room Practice....The Foundry Trade School ....Glass Covered Desks—Roller Bearings	848-851
Business Ability	852
Automobilism to Excess	852
Boston Meeting of the American Foundrymen's Association	853
Commencement at Hoe's Apprentice School	853
Notes for the Drawing Room	853
Civil Service Examinations	854
Technical Publications	854
Personal	855
Obituary	855

We would be glad to have all the material our friends may receive from the Cleveland oil swindlers within the next month or two.

Business Ability.

A machinist who has lately become interested in a machine-tool establishment was saying the other day that for years he had been occupying various positions of responsibility as foreman, superintendent, designer, etc., in machine shops and no one (including himself) had ever suspected that he had possessed anything resembling business ability. Now, however, that he is with a concern building a machine of his own design he finds that about half of the orders that are secured are secured by himself personally, and that usually where an order is to be gotten by going after it he is the one called upon to do the going. The fact is one of numerous illustrations that might be cited to show that very many men who are not suspected of having business ability because they are not in a position to exercise such ability nevertheless really have it. Business ability has been defined as good judgment and common sense and a great many mechanics have the necessary judgment and common sense to become good business men. The fact that a man has not business ability is not proven until he has tried to conduct business affairs and has failed and this is a fact which it might be well for very many mechanics to remember who fear to put themselves in a position where business ability is required because they have become impressed with the idea that the business faculty is a rare one. The main things in conducting a machinery business are to know the machine thoroughly, to know other people's machines thoroughly, and to be alert, to exercise what has been called "horse sense," to have "gumption"; and so long as a man has never done anything else than strictly shop work of course it is open to anyone who chooses to guess that he has little or no business ability. The old story of the man who was asked if he could play the fiddle comes to mind. He said he didn't know whether he could or not; he had "never tried." So it is with the intelligent machinist about doing business. He should not conclude that he cannot do business until he has tried and failed. The chances of success are much greater than of making music on a violin at the first trial.

Automobilism to Excess.

It is scarcely left to us now to question whether the self-propelled vehicle on common roads will not in time—perhaps a longer time than some would have us believe—render the horse superfluous in that line of service. It seems to be adapting itself to all the various lines of road use in which the horse has been for ages employed. The automobile can be, and is already, used for riding for either business or pleasure, and various motor cars are in use quite numerously for the transportation of goods both light and heavy in most of the larger cities. The best mechanical talent of the world is constantly employed in the further development and improvement of this new line of mechanical appliance.

Probably few have given thought to the enormous cost of bringing the autocar into actual, practical serviceability in all its details. Time and labor have to be given without stint to mere experiment; and successive machines are built and tried and soon must be thrown away without bringing any remuneration except in the suggestions for building other machines to be also superseded. Even when a vehicle or a class of vehicles is considered so satisfactory as to warrant their manufacture in numbers those too are usually several times thrown out before they can begin to prove profitable to their makers. This has been the experience in the development of many modern devices, but is especially true of the automobile industry. The money sunk in this way can never be stated in figures and can only be estimated, but it must amount to a vast sum.

In connection with the development of the automobile men of wealth have had a unique opportunity. Much of the vast expense attending the development they have been able to bear, without any benevolent intent, by buying the experimental machines. The automobile, beginning distinctly as a luxury, has been supported by those who have been able to afford it. As successive improvements have been made in the machines those who have bought one have, many of them, bought successively others, and purchasers of this class have lately become dictators as to the style of machine they would have. A passion for speed has easily grown by its easy gratification, and now the call is for racing machines. These we have capable of speeds above a mile a minute. Being built for speed they very naturally are speeded wherever there is an opportunity, and the opportunity is made by driving on the public highways and in much frequented streets with the result of often killing or maiming those who have a right to walk in safety. All this is much to be regretted. The machine is being developed by this not along the lines of usefulness or of permanent service, but in a way which must inevitably be fatal to it if persisted in. The public very properly will not submit to the danger, and the users of the racing machines cannot fail to tire of the cheap excitement. The automobile does not and never can lend itself to regular "sporting" purposes, for the very necessary element of uncertainty is so soon eliminated. The ultimate speed of any machine can be ascertained, and that ends it for racing. The mere brutal pleasure of driving full tilt through streets used by pedestrians and for the ordinary traffic of

horses we may be very sure will soon be interfered with and put a stop to, so that there cannot possibly be any future for the mere racing machine. Builders who are hoping to develop a permanent business in the building of automobiles will do well to look ahead, and if they do so they will be planning for something better than racers. These have shown at least one thing. There is no question at all about the power required, as they embody it in excess, and much better machines can be produced by taking off the excess of power and lightening the machines. The line of development which has been followed is not at all to be wondered at, but there should be a switching off to the practical where alone can be permanency.

Professor Pupin, having characterized the practice of telegraphy in America as very backward and the company controlling showed as unwilling to give any new idea a trial, the chief engineer of the Western Union Company rashly undertook to defend his company, whereupon the electricians generally not only reassert Professor Pupin's position, but—prove it to be correct; and, as the case now stands, it seems to be demonstrated that the Western Union has used its monopoly of telegraphing to retard and stand in the way of every proposed improvement to the utmost of its great ability and opportunities. Thus is the last estate of that company made worse than its first, and one of the dearest arguments of those who oppose government control and operation of the telegraphs as part of the postal system, as is the general practice in Europe, gone glimmering.

Boston Meeting of the American Foundrymen's Association.

The American Foundrymen's Association is to meet in Boston, June 17 to 19, inclusive. The business sessions will be held in the Assembly Hall of the Massachusetts Institute of Technology. At the first session on Tuesday morning, June 17, besides the reports of the various committees and other routine business, there will be the presentation of the Standard Specifications for Steel Castings as adopted by the American Association for Testing Materials, and memorials on the Insuring of Patterns, by Frederick Conlin, and on the Proper Valuation of Pig Iron for Foundry Purposes, by Dr. Richard Moldenke. At the other meetings the following papers will be presented:

Some Methods of Increasing Foundry Production, by David Reid; Shop Conditions, by Hugh McPhee; Foundry Costs, by R. P. Cunningham; Cores and Core Arbors, by Edw. B. Gilmour; Shop Tools and Rigs, by Jas. A. Murphy; Technical Education, by Prof. R. H. Richards; The Molding Machine—Jigs, by S. H. Stupakoff; The Effect of Melting Steel with Iron in the Cupola, by H. E. Diller; The Metallurgy of the Cupola, by Herbert E. Field; Economy, by P. R. Ramp; Foundry Accounting, by James G. Stewart; The Molding Machine—Flasks, by S. H. Stupakoff; Brass Melting, by Chas. Vickers, and Cast Iron, by Percy Longmuir. There will also be lectures by Dr. Fay, on the Preparation of Metallographic Specimens for the Foundry and by Albert Sauveur, on the Application of Metallography in Foundry Work.

The entertainments and excursions provided seem to cover every waking minute not occupied by the business sessions.

Commencement at Hoe's Apprentice School.

R. Hoe & Co., the old printing press firm of this city, maintain a school in which they teach their apprentices English, mathematics, mechanical drawing, mechanics, etc. There are six classes, each of which is a four months' course, and three or four years are usually consumed in completing them all. After graduation, with the receipt of a diploma, the boys may take a year's special course in physics, chemistry or some other subject in which they have shown special aptitude.

The closing exercises of the school were held in a neighboring church last week. About eight young men were graduated. Prizes were awarded, consisting of a gold watch, books and instruments. Addresses were made by Robert Hoe and M. B. Philipp, a patent lawyer. Afterward there was an entertainment, consisting of music, sleight-of-hand tricks, etc.

Notes for the Drawing Room.

BY G. E. FLANAGAN.

Large sheets for detail drawings have some advantages of their own, and in some cases their use is unavoidable owing to the class of work done; but much time and some money may often be saved by supplementing them with a system of cards for small details, showing only a single piece on each card, the drawing at times being only a freehand sketch, producing one or more copies immediately by means of carbon paper. It is generally better to give all drawings, whether cards or full sheets, a serial number, even when they are indexed and filed by another system. It records the order of their production, notes the number of them which have been made up to date, indicates clearly the gap in the system in case any may have been lost or destroyed, and furnishes the simplest and most precise mark by which a drawing may be known. On the cards the letter "C" is used in connection with the serial number and should be written over it, thus $\frac{C}{1396}$, to avoid confusing with C-1396, the latter being a detail marked C on sheet 1396. The same serial number should not, however, be used for both a sheet and a card, and thus avoid the possibility of error from this cause. Sometimes the plan is adopted of using only even numbers for sheets and only odd numbers for cards, or the numbers from 1 to 10,000 may be reserved for sheets and those for 10,001 to 20,000 for cards. The cards should be made from either tracing cloth or bond paper, from which blueprints may be made. They should be kept on hand, numbered ready for use, and if any title or other matter common to all is required, it will save labor to have them printed.

When a machine is to be built involving slight modifications of existing patterns, the details of which are shown on various large drawings, forming the record of previous work or showing standard designs that it is not desirable to have changed, the card system, as supplementary to the drawings, is of greatest use. For each detail requiring any alteration, a card is prepared showing the changes only and referring back to the original sheet for the general construction. The print from the drawing goes into the shop with a print from the card fastened to it, in most cases showing the requirements as clearly as a new drawing could have done. As a matter of fact, so far as the workman is concerned, the result is better than a new drawing, as it shows at once wherein the present case differs from what he has done before, and he is not reduced to the necessity of making this discovery for himself. For instance, with a new drawing a patternmaker would have to check over every part of the pattern to make sure that no small change has been overlooked. When the required alteration is distinctly shown and the pattern is known to agree with the original drawing, the matter is much simplified. A complete bill of material is made out in which the details are called for by the card numbers, not by the original drawing number. This precludes the possibility of any details being made without embodying the necessary changes. Perhaps the most customary, and at the same time one of the least satisfactory, methods of using old drawings to build new machinery is to mark the changes directly upon the blueprints. This calls for a great deal of labor where several sets of prints are required for use in the shop, in addition to a set for record in the drawing office, and they are a cumbersome species of record at the best. To show changes in a print clearly, the superfluous lines and figures upon it should be blotted out with water color, or even rubbed over with a blue pencil, in place of being merely crosshatched with a pen, as is commonly done.

Of the various methods of marking upon blueprints some are better and some are worse, and some are very much worse. For rough and ready use, red pencils and yellow pencils are available, the use of these colors being, at times, restricted to certain individuals, thus showing at a glance by whom the notes have been made. For general marking, solutions of common soda, bicarbonate of soda, caustic soda

and various other salts, including potassium hydrate or caustic potash, are used. All of the above are objectionable from one cause or another, and the caustics may even prove dangerous under certain circumstances. There are on the market many prepared fluids which serve the purpose admirably, but are somewhat expensive, and, for a satisfactory substitute, a solution of potassium oxalate in water possesses nearly all the good qualities of the best of them. The solution should be made saturated; that is, to contain as much of the chemical as the water will dissolve, and after standing for a time the clear fluid should be poured off into a clean bottle and a little fresh water added, reducing the strength of the solution. This liquid makes a clear mark upon the print and will not spread through the fiber of the paper when writing, nor from contact with the fingers, after it has once become dry. In fact, the print may become water soaked without injury to the marking.

The addition of fractions forms a not unimportant part of the mental drudgery of a draftsman's labors, and this burden may be materially lightened by the exercise of a little method. Many long lines of dimensions are symmetrical about a center line. In this case the addition is made easier by taking only half of them, but at double their value. For instance, 1 1-32, 1 11-16, 3, 1 11-16, 1 1-32 inches may be added as 2 1-16, 2 11-8, 3 inches, thus reducing the number of figures and putting them in simpler form. In the same way, where figures such as 18¾, 21½ inches appear upon a drawing, many draftsmen reduce them to feet and inches before adding, while others add them as they are written. In this case whichever method one is most accustomed to will appear the easier, except that if the work is done mentally it is far better to take them as they are written, and make the reduction at one operation.

The borrowing habit is a disease that sometimes attacks draftsmen, in common with the rest of the world, and few among them realize how seriously yielding to this tendency retards their progress. It occurs to many that as long as they can do their work without incurring the expense of additional purchases of books and tools they may as well do so, but this is a very grave mistake. A man can always do more and better work with tools to the feel and action of which he has become accustomed, than he can with those which are unfamiliar to him, but this is still more essentially true in the case of books. Books of reference require to be owned by the user, so as to be constantly in his possession in order that he may become as familiar as possible with their contents. It is beyond the capacity of any human being to memorize more than a small fraction of the information which the engineer requires to have immediately available. A knowledge of where the information is to be found and how to apply it to the work in hand is all that can be attained to, and this will be supplied by a comparatively few books in constant use better than by a large library consulted at rare intervals. In the case of such books as Trautwine and Kent, the user will do well to arrange a thumb index to suit his own particular requirements, and this suggestion also applies to the pocket books furnished by various manufacturers. These books may be indexed by cutting away more or less of the margin of the leaves, so as to leave exposed a portion of the page it is desired to index. These exposed margins then follow each other down the side of the book, giving the effect of a succession of steps. They may be made very small, as abbreviations can always be found which will be sufficiently clear to one making constant use of the book.

Civil Service Examinations.

The United States Civil Service Commission, Washington, D. C., announces that on July 8-9 an examination will be held at places scattered throughout the country, for the position of computer in the Coast and Geodetic Survey, at a salary of $1,000 per annum, and other similar vacancies as they may occur. Persons who are unable to file their applications, but whose requests are received at the Commission in sufficient time to ship examination papers to the places selected, will be examined.

The chief examiner of the New York State Civil Service Commission, Albany, N. Y., announces among other examinations to be held June 28, one for assistant electrical engineer at $40 to $60 a month and maintenance. It will be held at various towns in the State.

The United States Civil Service Commission will also hold an examination, July 8, at the various places, for engineer, Bureau of Chemistry, Department of Agriculture, at $2,000 a year, and similar positions as they may be open. It will require an engineer competent to conduct tests of the strength of building materials.

Technical Publications.

"Alternating Current Machines." By Samuel Sheldon and Hobart Mason. 259 5½x7½-inch pages with 184 illustrations. D. Van Nostrand Company, New York; Crosby, Lockwood & Son, London. Price, $2.50.

This treatise is a companion volume to the corresponding treatise on Direct Current Machines by the same authors. It is intended for use as a text book in engineering schools and also by electrical and other engineers who need to familiarize themselves with the subject. The treatment is mathematical though not burdensomely so. Those who can read the simpler calculus demonstrations will find the book simple, compact and to the point.

"The Power Plants of the Pacific Coast." By F. A. C. Perrine. 24 8x10½-inch pages, fully illustrated. Transactions of the New York Electrical Society.

This paper is intended to call attention to the great things in electrical engineering which are to be found on the Pacific coast. That coast has long been in the lead in the length of its distribution lines, as well as in the voltages employed, while in severity of conditions successfully met there is no other locality which even approaches it. In one instance energy aggregating several thousand horse-power is used at a distance of 218 miles from the point of generation. Heads as high as 1,450 feet and electrical pressures up to 40,000 volts are employed. To the boldness to which such achievements are due we of the effete East must respectfully doff our hats.

"Electrical and Magnetic Calculations." By A. A. Atkinson. 310 5x7-inch pages, with 46 illustrations. D. Van Nostrand Company, New York. Price, $1.50.

The object of this book is given with sufficient clearness by its title. It is not intended to be of necessity read entire, the arrangement being such that such chapters as those devoted to the relation of heat and chemical energy and to alternating currents may be passed over if desired. While the subject necessarily involves mathematics the treatment is, in this respect, simple and involves nothing deeper than common algebra. While the principles are worked out and the book is thus essentially a treatise, it will no doubt also serve a useful purpose as a reference manual to those who have more or less electrical calculations to make. A large number of practical problems is included.

"Refrigeration, Cold Storage and Ice-Making." By A. J. Wallis-Tayler. 590 6x9-inch pages with 361 illustrations. Crosby, Lockwood & Son, London; D. Van Nostrand Company, New York. Price, $4.50.

Refrigerating machinery has long deserved such a treatise as this, in which the theory of the subject from the thermodynamic standpoint occupies a subordinate place. The field is covered in a comprehensive and at the same time a thorough manner. Following the descriptions of the different systems of refrigerating machines which have been and are now made, the other features of refrigerating plants are discussed in a very instructive manner. Among the subjects thus treated are Cocks, Valves, Pipe Joints, Brine Circulation, Direct Expansion and Cold Air Blast Systems, Systems of Piping, Construction and Arrangement of Cold Stores and Chambers, Ventilation, Insulation, Hoisting and Conveying Machinery, Proper Methods of Storing and Temperatures Suitable to Various Articles; Manufacturing, Industrial and Constructional Applications; Various Methods of Ice Making, Management and Testing of Refrigerating Machinery and the Cost of Working.

Stevens Institute of Technology has issued a beautifully gotten up book as a souvenir of the exercises attending the dedication of the new Carnegie Mechanical Engineering Laboratory, an account of which we gave at page 246.

The dignity of a cable despatch is given the announcement that an engineer of the Canary Islands has devised a method of extracting electricity from the atmosphere "without the use of chemicals or a dynamo or any motive force." Franklin did a thing very like this when he flew his kite; but making practical use of atmospheric electricity is a different matter.

Quite an unusual privilege was accorded the two American naval officers, Captain O'Neil and Commander Beehler, who attended the Naval Congress at Dusseldorf, in allowing them to visit and quite thoroughly inspect the Krupp works at Essen. It has been the custom to rigidly exclude all foreign naval officers, and it seems fitting that Americans should be the ones first favored in the opening of the doors, as we have been so free to show everything we do and how we do it.

On May 16 was celebrated at the Canada Tool Works, Dundas, Ont., the fiftieth anniversary of the wedding of John Bertram, president and founder of the firm of John Bertram & Sons Company, machine tool builders. All the employees gathered in the large fitting department and presented Mr. and Mrs. Bertram with an onyx-topped stand and gold-mounted vase, a bronze clock with ebony base and gold mountings and—for Mr. Bertram's special use—a gold-lacquered smokers' companion, besides an illuminated address. It being also the twenty-fifth anniversary of the wedding of Col. Alex. Bertram, a member of the firm, he and Mrs. Bertram were presented with a case of silverware. Mr. John Bertram is one of the pioneers of the machine tool industry in Canada. He came to Dundas from Leith, Scotland, in 1852, and the extensive establishment of which he is now head was but a small shop when he first connected himself with it.

We have received from the National Reciprocity League, 421 Adams Express Building, Chicago, Ill., a copy of its Constitution and By-Laws, with list of officers and set of resolutions adopted by the League, etc. This organization is a non-partisan one intended to advance the sentiment in favor of reciprocal trade relations with foreign countries, and those of our readers who may be interested in it will receive copy of Constitution and By-Laws by addressing the secretary of the League, A. B. Hulit, at the address given above.

Personal.

Superintendent Carney of the inspecting department of the Russell & Erwin Manufacturing Company, New Britain, Conn., has left for St. Petersburg, Ont., where he becomes general manager of a lock concern.

W. S. Morris has been appointed mechanical engineer of the Erie Railroad Company, to succeed J. M. Barr, resigned. He comes from the Chesapeake & Ohio, where he has filled the position of superintendent of motive power since 1893. He is an experienced machinist.

At a meeting of the Engineering Faculty of the Ohio State University, on the 3d inst., Prof. Edward Orton, director and professor of the Department of Ceramics, was elected Dean of the College of Engineering, the position formerly held by the late Professor Brown.

J. O. Emanuel Trotz, late superintendent of the South Works of the American Steel Company at Worcester, Mass., has been appointed chief metallurgist of the United States Steel Corporation and adviser to President Charles M. Schwab. The new position of Mr. Trotz is considered one of the most important in the United States Steel Corporation.

Alexander C. Humphreys, who for some time has been a trustee of the Stevens Institute, was elected on the 5th inst. president of the Institute. Mr. Humphreys is a graduate of the Institute, has been a president of its Alumni Association and is also interested in manufacturing enterprises. A short time ago he gave to the Institute $10,000 for the purpose of founding a scholarship in memory of his deceased son.

Professor Charles L. Griffin, who has occasionally contributed to our columns, and who for some time past has been in charge of the Department of Machine Design of the Pennsylvania State College, has been elected Professor of Mechanical Engineering in the College of Applied Science, Syracuse University, where he will be in charge of the development of the mechanical engineering course. This is a new school of engineering which has been endowed by Mr. L. C. Smith of the Smith Premier Typewriter concern.

Obituary.

Leonard Geiger, an inventor, died at Hudson, N. Y., June 4, seventy-three years old. Mr. Geiger was a native of Germany and came to this country in 1849. He found employment with a railroad, but later engaged in the marble business at Hudson. He built a workshop at his home where he developed his inventions. He invented the Remington rifle and a jacket bullet, which was used by many nations.

Eugene A. Kowalewski, of the machinist firm of Kowalewski & Ruesch, Newark, N. J., died last week, thirty-eight years old. He was born in Connecticut and learned his trade in the shops of Gould & Eberhardt, Newark. At the age of twenty-one he was superintendent of the Stiles & Parker shops and later was with the Universal Radial Drill Company. He had been in the business of which he was the senior partner seven years.

Commercial Review.

NEW YORK, Monday, June 9.

We have always supposed that New York's industrial status, aside from the sweat shops, was that of a distributing center, but to present external appearances this city is hourly becoming one of the greatest crude industrial towns in the country, not to be outdone in dirt by those of the Ohio Valley. If by the end of another week or so, as the newspapers threaten, all the big office building chimneys are belching out soft coal smoke your correspondent will be collecting commercial reports with a lantern. It is to be hoped that if the affairs of the coal-esced mining companies should convert Wall street into a smoke house for the next few weeks or months public interests will in some way manage to pull through.

The strike is of course affecting trade to some extent. It tends to make parties who have inquiries out cautious about finishing up their business. We do not find, however, that this industrial embroilment is foremost on every tongue. The dominant note in the machine-tool line is an extremely cheerful one, although it is admitted that trade is not at its highest point of the year. Prices are advancing in various instances. One machine-tool man tells us that he knows of four concerns which are advancing them this month—the increase in at least one case being very considerable. Two of the raises alluded to are made by lathe manufacturers.

In the machinists' supply line business has for some time been slackening, but according to last accounts we have heard is excellent still. It is commonly admitted that never before has there been so good a year since a time whereof the memory of man runneth not to the contrary. We judge from what we hear that an increase of 20 per cent. over last year is pretty widely applicable as an estimate. In one case an increase of 40 per cent. is named.

The South African peace seems to render necessary some allusion to the machinery prospects which it opens up. The edge, however, has been taken off of the present occasion by the fiasco trade boom that followed Lord Roberts' advance two years ago. Since then, also, there has been an opportunity gradually to rehabilitate the mining situation without waiting for the establishment of peace throughout the entire region. Undoubtedly a good proportion of manufacturers will be satisfied with a chastened enthusiasm and will agree that the spirit which sees in the devastation of a territory by war only an occasion to raise a grand hallelujah over the money that is to be made out of it, is a little too suggestive of the harpies who plunder the corpses of the dead. That a wasted soil

is not that from which most readily springs prosperity, we have learned, or ought to have learned, from the case of Cuba.

Since the news of peace in South Africa a representative of the Allis-Chalmers Company has expressed himself as follows: "After the army of occupation is reduced from 225,000 men to a garrison of 50,000 men, it will be easier to expedite shipments to the mines. Then we expect the South African demand for our hoisting machinery, stamp mills, and cyaniding apparatus considerably to increase. There has been no noteworthy expansion as yet, and won't be until the railroad is freer than it is now. We keep no stock at the Cape, so the first demand will probably fall on the English makers, who have some of their product already in store there. The movement of supplies to the Rand will needs be slow; there is only a single-track road, and that but 42 inches wide, running thither from the Cape. As our customers never specified the Delagoa Bay route for their shipments before the war broke out, I hardly expect them to use it now." The above was confirmed to an AMERICAN MACHINIST man who called at the New York office of the Allis-Chalmers Company as a fair statement of the view taken. The company is not inclined to boast of getting all the orders that are to be placed by the mines away from English manufacturers—in fact, quite otherwise—but it is represented on the field and evidently is expecting a pretty fair demand sooner or later for mining machinery, to which line it thinks the early requirements of the country will for the most part be confined. It believes that English manufacturers have caught up with their orders so as to be better stocked than the American, but that the former are apt to ask rather high prices for their goods, so that perhaps the advantage of price may be said to be with us. The cost of freights may be regarded as about on an equal basis.

A representative of this paper called also at the office of the Ingersoll-Sergeant Drill Company and saw the vice-president, W. L. Saunders, who remarked that the future was unknown to him as to others. In answer to questions, he said that the termination of the war seemed to have been anticipated in the way of business; also that the English, perhaps, have an advantage as regards delivery and price. His tone was, in short, conservative. A voluminous letter had just been received from a representative of the company on the field, but he had not finished perusing it.

At the office of Sheriff, Swingley & Co., who are prominent in export trade to South Africa, it was impossible to learn anything in the absence of Mr. Swingley, who is in South Africa, where he will remain for many months.

One of the most important orders lately received in local machine-tool circles was booked by the Garvin Machine Company. It calls for about $25,000 worth of machinery for a manufacturer of sporting arms.

Now that Lewis Nixon of the Crescent shipyards, Elizabethport, N. J., has had his try at investigating Tammany Hall from the inside and later at bossing it, he is interesting himself in a new shipbuilding trust. The details of this proposed combine have not yet authentically been made public, but Mr. Nixon has admitted that there is something in the project and that one of its objects would be the specialization of work—allotting merchant vessels to a particular yard, yachts to another, etc. Among the yards rumored to be in this project are the Union Iron Works, the Newport News Shipbuilding and Dry Dock Company, the Bath Iron Works, the Bath Windlass Company, the Harlan & Hollingsworth Company, and the Crescent Shipyards. It will be remembered that there were plans for a combine of somewhat the same sort more than a year ago, but they fell through.

The Merchants' Association of New York is sending out a leaflet calling upon the merchants of the United States to use their influence to secure the passage of the Ray bill for the amendment of the present bankruptcy law. This bill is calculated to prevent moneys paid within four months of bankruptcy from being of necessity considered a preference. It aims also to prevent discharges in case of fraud, etc., to expedite settlements in bankruptcy and to render more definite the conditions under which credits may safely be given, thus making it easier to obtain credits.

Bids were opened, June 2, on a quantity of machine tools, etc., for the Boston Navy Yard. Competition was not lively. On some lots there were no bids at all, and on many of them only one. For instance, Hill, Clarke & Co., of that city, were sole bidders on the following: Pipe threading and cutting-off machine, $839; drill press, $240; straightening machine, 5 inches capacity, $149; ditto, 2½ inches capacity, $39; 30-inch gap punch, $1,500; universal shear, $1,325. The same firm were lowest bidders on a set of hand-bending rolls, $510. Bement, Miles & Co. were lowest on a single frame steam hammer, at $525. Jones & Lamson Machine Company made the sole bid of $1,550 on a flat turret lathe. The Detrick & Harvey Machine Company made the only bid on an open-side planer, $1,886. Hendey Machine Company and Hill, Clarke & Co. each bid $850 on a 24-inch pillar shaper, and the remaining bidder was but $5 higher.

The Brown Hoisting Machinery Company was the only bidder, June 2, on a ten-ton locomotive crane required for the League Island Navy Yard. The figure put in was $6,795.

For the Portsmouth (N. H.) Navy Yard bids were opened, June 2, on a triplex power pump, the lowest bidder being the Stilwell-Bierce & Smith-Vaile Company, at $666 and $649.95; also on three 15 horse-power, two 7½ horse-power and two 3 horse-power shunt-wound motors, the lowest bid out of nine being put in by H. B. Coho & Co., New York, who named $1,890.

At the newly enlarged Pratt street power station of the United Railways and Electric Company, Baltimore, Md., the C. W. Hunt Company, of New York, has lately installed an up-to-date plant for receiving and transporting coal and conveying off ashes without the use of the shovel. There are sixteen 500 horse-power Babcock & Wilcox boilers on the first floor and the same number on the second. Above the boilers on either side of the stacks are two coal bins, having a storage capacity of 6,000 tons. Over each of the bins is the Hunt automatic railway, extending the length of the building, and into the towers. The two steel towers were built for hoisting the coal, one of which has been equipped throughout, while work on a duplicate equipment is in progress. This plant, it is stated by the Hunt company, has the highest hoist of any power station, and is the only one of its kind equipped throughout with electrically operated hoisting and conveying machinery. The electrical apparatus in the tower was arranged by P. O. Keilholtz, consulting engineer of the railway company. Each of the coal hoisting towers is 183 feet high, and the horizontal boom, 52 feet in length, extending over the water. The tower has a capacity of 50 tons or more of coal per hour. While the consumption of coal in a station of this size would probably be 100,000 tons per year, the coal handling plant has a capacity of ten times that quantity of fuel taken from the boat and delivered to the storage bins.

The American Tool Works Company, of Cincinnati, Ohio, manufacturer of a general line of metal working machinery, is opening up a new store and office in the heart of the machinery district of St. Louis, 720 North Second street, at which address a representative stock of their machines will be on exhibition. A. B. Bowman, who has been identified with the machinery business in St. Louis for many years, will be the agent at that office.

Gay & Ward, of Athol, Mass., manufacturers of cutters, etc., are very busy and have had to put on a night force to keep up with orders. They are enlarging their plant.

The Automatic Machine Company, Greenfield, Mass., has purchased the business of the New England Screw Company, Thompsonville, Conn., and will hereafter manufacture the line of automatic forming lathes, etc., of that concern in connection with its own regular business.

The Hampden Corundum Wheel Company, Brightwood, Mass., has ready for occupation its new plant with a capacity three times as great as that of the old works which were burnt. The new factory has an up-to-date equipment and the com-

pany is in a position to fill all orders promptly.

The Bowen Manufacturing Company, Auburn, N. Y., is adding a four-story building, 40x60 feet, to its present factory, and has added several carloads of automatic machinery to its plant. The company is fast reaching out for new work in the line of machine screw and press work, and it is increasing its regular line of oil and grease cups.

The secretary of the Clyde Shipbuilders Association, in conjunction with John Macdonald & Sons, local agents for the Chicago Pneumatic Tool Company, have arranged for a six weeks' trial of pneumatic tools, which was to begin first in the yard of Scott & Co., Greenock, Scotland. Three of the best workmen from Chicago have gone over for the purpose. The tools operated will be those used recently on the American liner "Zeeland" at Southampton, and later on the Cunard liner "Etruria" at Liverpool. A new stern piece was put on the Cunarder which required 1½-inch rivets through 9 inches of material. At Scott & Co.'s yard the work will be mostly on a merchant vessel of 8,000 tons. It is said that many of the leading shipbuilders in Great Britain have accepted the invitation of the Clyde Shipbuilders' Association to visit the yard while the work is being carried on. The tests will include varied classes of work.

CHICAGO MACHINERY MARKET.

The stocks of machine tools now kept in warehouse or in store at Chicago run more largely to big machines than ever before. There are houses here which two years ago would scarcely think of keeping a six-foot drill on the floor, because of the uncertainty of its early sale. Now machines are commonly kept in warehouse so large that they cannot be made a part of the regular store display. These big machines are not easy to obtain from factory, but once in stock there seems to be as little trouble in disposing of them as of the smaller sizes. It is in goodly measure the sale of these large tools that is giving to the Western machine trade its comforting proportions. A few machines running from $1,000 to $1,500 or more each count more rapidly than tools running down to one-tenth those prices.

Business in machine tools is uniformly pronounced satisfactory. The term "healthy" was applied to trade by one large seller, who defined the word by saying that he meant a steady run of medium-sized orders, without any of remarkable size to swell the month's business to an unusual aggregate. May footings were almost invariably in excess of those of April. And when comparisons are made with the corresponding month of 1901 the results are strongly in favor of this year. One seller of wood-working machinery remarked that if June returns an average report, his business for the first half of this year will exceed that for the entire year 1901. This may be an extreme instance, but the volume of Western business for the six months this year will in the aggregate be far ahead of that of 1901 during the similar period. As compared with May, the first week of June did not on the whole make a very favorable showing. This is supposed to be due to the presence here of an epidemic of strikes and other temporary conditions. The outlook for business is good.

Deliveries from factory are not improving. The average is from three to twelve weeks or longer, according to size and other conditions. The demand for machine tools comes from all sources, with the railroad companies among the leading buyers. A machine-tool representative remarks that the present policy of some of the railroad companies seems to be diametrically opposed to what it was a short time ago in the use of their equipment. Formerly they carefully guarded the length of service of a locomotive or car by periods of rest and constant repair; now they get the desired mileage out of it at the earliest possible moment and then scrap it. The changed policy may have been born of necessity, but it keeps things humming in some of the shops.

Armstrong Bros. Tool Company is re-equipped after its fire in better shape than ever.

The Camp Engineering Company, 47 West Lake street, Chicago, rebuilders of second-hand engines, report that the engine business for May exceeded all expectations, they having shipped machinery right and left. They state that the prospects for June are even brighter and the call for first-class rebuilt machinery which has been dormant through the winter and spring, seems to have awakened from its long rest with redoubled energy.

Quotations.

NEW YORK, Monday, June 9.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$21 15	@$21 65
No. 2 X	20 65	@ 21 15
No. 2 plain	20 15	@ 20 65
Gray forge	19 65	@ 20 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	20 25	@ 21 25
No. 2 foundry, or soft	19 75	@ 20 75
No. 3 foundry	19 25	@ 20 25
Foundry forge, or No. 4	18 25	@ 19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93 @ 2.03c. in carload lots. Smaller quantities from store, 2.10 @ 2.25c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Copper—Lake ingot, 12½ @ 12⅝c.; electrolytic, 12¼ @ 12⅝c.; casting, 12¼ @ 12½c

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 29¾ @ 30½c.

Pig Lead—4.10 @ 4⅛c., in 50-ton lots.

Spelter—New York delivery, 4⅞ @ 5c.

Antimony—Cookson's, 10 @ 10¼c.; Hallett's, 8¼c.; U. S., 8 @ 8¼c.; various brands, 8c.

Lard Oil—Prime City, 79 @ 82c. in wholesale quantities.

Manufacturers.

The Big Four is about to build car shops at Springfield, O.

An addition is to be built to the Victoria Plush Mills, at Swarthmore, Pa.

Col. W. H. Dowe and his associates will build an electric railway at Shoshone Falls, Idaho.

Robert Dobson & Co., manufacturers of woolen goods, Pittsfield, Me., will build an addition.

A. R. Cushman expects to rebuild the paper mill at Cushman, Mass., which was burned recently.

The Buckeye Index Company, of Cleveland, O., will remodel buildings at Niles to be used as a factory.

William Sellers & Co., Philadelphia, have filed plans for a new flask shop and foundry, 115x117 feet.

A large flouring mill of R. O. Gathright Company, Louisville, Ky., has been burned, but will be rebuilt.

A permit has been issued for a $16,000 addition to the North Works, Illinois Steel Company, Chicago, Ill.

A new factory is to be built for William Ayres & Sons, manufacturers of horse blankets, Philadelphia, Pa.

Work on the plant of the new Sharon Brass & Foundry Company at Wheatland, Pa., is progressing rapidly.

The Delaware Hard Fibre Company, of Wilmington, will erect an addition to its plant to cost about $150,000.

The owners of the Black Jack mine, Grangeville, Idaho, will install a 20-stamp mill this fall. Simon Adams is president.

A four-story, $25,000 factory is to be built in Chicago for G. F. Moore, manufacturer of moldings, 394 Bowery, New York.

The Columbia River Lumber Company, Vancouver, Wash., will put in new machinery for a large sawmill and planing mill.

Fire has destroyed the plant of the Greenfield Manufacturing Company, manufacturer of handles, chairs, etc., Greenfield, Ind.

It is reported that the ship yard of W. A. Boole & Son, of San Francisco, Cal., is to be considerably enlarged in the near future.

The Columbus (O.) Bolt Works have taken out a permit for the erection of a four-story office building and warehouse, 40x80 feet.

The Copper Glance Mining Company, near Bisbee, Ariz., is arranging for the installation of a hoisting plant in the near future.

The Russell & Erwin Manufacturing Company, New Britain, Conn., has been clearing the ground for a new factory building which it is to erect.

The directors of the Coldwell Lawn Mower Company, Newburgh, N. Y., have decided to build an addition of 85 feet on the north end of the factory.

Superintendent J. R. Treglon, of the South Spring Hill mine, Sutter Creek, Cal., says his company will spend $250,000 in improvements this year.

The plant of the Sugar Pine Door & Lumber Company, Grant's Pass, Ore., has been

destroyed by fire, together with the Williams Bros. & Kendall sash and door mill.

A $32,000 corporation will rebuild on an enlarged scale the butter tub factory of the Spurbeek-Lambert Company, Algona, Ia., which was burned a few weeks ago.

The North Shore Railroad Company, San Francisco, Cal., has decided upon a bond issue of $1,375,000 for improvements, including an electric generating station.

A building permit has been issued to the Bemis Omaha Bag Company, Omaha, Neb., for a factory building to cost $36,000. It will be six stories tall with a basement.

C. C. Mengel, Jr., & Bro. Co., Louisville, Ky., has secured a permit to build a mahogany mill. It is understood that the firm will expend $50,000 in placing machinery.

According to a statement of A. L. Steinmeyer, secretary of the Columbia Copper Company, a copper manufacturing plant will be built in New Orleans, La., at an early date.

H. W. Carr, owner of the Redding (Cal.) Foundry & Machine Works, has sold his plant to a Sacramento company which will enlarge the plant and place new machinery and tools in it.

The Cone Export & Commission Company, 74 Worth street, New York city, and Greensboro, S. C., proposes to locate a new $1,500,000 cotton mill somewhere in the vicinity of the latter.

The St. Louis (Mo.) Car Wheel Company is about to erect a branch foundry in Atlanta, Ga. The building will be 95x230 feet, with wings for the engine and boiler rooms, coke ovens and cupola.

The Board of Supervisors, Nevada City, Cal., has sold to the Central California Electric Company the franchise to construct and operate an electric power and light line on the county roads and highways.

At the Fremont Consolidated Mines, Amador City, Cal. (C. E. Purrington, superintendent), a 300 horse-power electric motor is to be installed to run a compressor. The company intends to erect an 80-stamp mill this summer.

The Chicago & North Western Railroad Company has been granted Chicago building permits for a number of structures, including $35,000 car shops, a $10,000 factory, $5,000 boiler-house, $10,000 dry kiln and $25,000 paint shop.

The Sterling & Skinner Manufacturing Company is building a factory in Detroit, Mich. It will manufacture brass goods for water, steam and gas. Temporary offices have been opened on the fifth floor of the Chamber of Commerce.

Work has commenced upon a factory to be erected at Brockton, Mass., for the Brockton Webbing Company. The power plant will be equipped with a 40 horse-power engine and 55 horse-power boiler. There will be a dynamo for lighting purposes.

The Washburn-Crosby Company has completed plans for a six-story brick flour mill, with a capacity of 3,000 barrels per day. It will be erected on the site of the old Humboldt mill, in Minneapolis, which will be torn down. It will cost $125,000.

The Hocking Valley has started the construction of a new brick shop in Columbus, O. It will be 100x200 feet, and will be used for the repair of locomotive tanks and boilers. The present boiler shop will be used as an addition to the machine shop.

The Ewart Manufacturing Company, link belting, Chicago, is adding a three-story building to its plant at Indianapolis. The new building is 150x180 feet, and will cost about $75,000. The company put up a two-story building last fall, 150x100 feet.

It is understood that books have been opened at the Enterprise Bank, Laurens, S. C., for subscription to the stock of the Wares Shoals Manufacturing Company, which proposes to develop water power electrically and presumably manufacture cotton.

Geo. Casey, J. K. Heslet and John F. Cowan have formed a company to furnish electric light and power for Butte, Mont. They have located 1,500 horse-power of water at Racetrack Creek, 25 miles from Butte, and propose to build a power plant.

Property on Sixth street, east of Broadway, Cincinnati, O., has been purchased in the name of Eugene H. Hughes, and is to be occupied by a cutlery and hardware manufacturing plant. Hughes is from Butler County and is one of the stockholders.

The Sheffield paper mills in Saugerties, N. Y., have been purchased by Colonel G. W. Thompson, president of the Diamond Mills Paper Company, of New York city and that place. He intends to invest between $15,000 and $20,000 in improvements and repairs.

It is stated at San Andreas, Cal., that J. B. Olson, a mining man of San Francisco, has purchased the Calaveras group and has set a number of men at work getting things in shape for extensive operation. A mill will be put up equipped with modern machinery.

A permit has been granted to the St. Louis Basket & Box Company to erect a new factory. It will be a veneer plant, equipped with the latest machinery and appliances. There will be four buildings. The intention is to have the factory ready for operation September 15.

The name of the Norwood Bicycle Company, Cincinnati, O., has been changed to Norwood Machine & Manufacturing Company. This does not affect the status or outside relations of the company. The business has, however, been reorganized and improvements made in the factory.

The Pneumatic Horse Collar Company, of Holland, Mich., is to fit up a factory there for that line of manufacture. The officers include: President and general manager, G. W. Browning; vice-president, J. C. Post; secretary, A. Visscher; treasurer, Charles H. Browning, of Battle Creek.

The Feather River Power Company has been incorporated by Chas. Webb Howard, et al., for the transmission of electricity from the Big Bend tunnel on the Feather River to San Francisco, Cal. The installation of a power plant and the building of a distributing system will be begun at once.

The Hall Bros. Marine Railway & Shipbuilding Company has been incorporated, to succeed the firm Hall Bros., important enlargements being contemplated at their plant at Port Blakely, Wash. The concern will devote itself chiefly to building and repairing sailing vessels. A marine railway will be one of the improvements.

The contract has been awarded for building the cable plant of the Stromberg-Carlson Company, at Chicago. The buildings at present will consist of a power-house and a main factory, the latter 210x298 feet. The motive power will be electrical and 600 horse-power generators will be used. The capacity of the plant will be 600,000 feet of cable a month.

It is reported from Cleveland, O., that the National Electric Lamp Company has closed a deal for the purchase of the land and factory buildings of the Brush Electric Company, at the corner of Mason street and Belden avenue. It is the intention of the National Company to use the factory for making lamps and other electrical goods, remodeling and re-equipping the buildings.

Work has begun on the new plant of the American Conduit Company, at New Kensington, Pa. The company was awarded a contract for 12,000 tons of material, and its product has been indorsed by the National Board of Fire Underwriters, of Chicago. The company has been experimenting for some time on an invention for a protective coating for such conduits.

Several large additions will shortly be constructed by Sargent & Co., hardware manufacturers, New Haven, Conn. The improvements, which have been necessitated by the increase in the company's business abroad, will cost in the neighborhood of $500,000. When the additions are finished Sargent & Co. will increase the payroll of the factory from 2,500 hands to 3,000 or 3,500.

A large mining enterprise is about to be launched at Parsons, in the Bonito district, N. M., where it is proposed to build a cyanide plant for the treatment of low-grade ore. A corporation known as the Eagle Mining & Improvement Company has been organized, with financial backing in San Francisco and the East. The first step will be the construction of a dam across the Bonito River to furnish water and power. Work is about beginning.

Armstrong Bros. Tool Company, Chicago, Ill., has completed the re-equipment of its plant and has entirely recovered from the confusion and delay incident to the recent fire. It has largely increased its facilities and is now in better shape than ever before to take care of its rapidly increasing business. Thirty thousand square feet of floor space and an ample equipment of up-to-date machinery are now devoted to the manufacture of Armstrong tool-holders.

Preparatory to the erection of an electrical power plant, to cost $6,000,000, the Commonwealth Electric Company, Chicago, Ill., has acquired a tract of land on the south branch of the Chicago River containing 616,066 square feet. It is the plan of the company to expend from $750,000 to $1,000,000 during the current year, and a like amount next year, and enough more as rapidly as the work can be pushed, to make the completed plant as large as any in the United States.

The Deming-Berry Company has been incorporated to succeed the Tacoma (Wash.) Automatic Scales Company. The works will be enlarged. A 200x60-foot building, with a 60x80-foot foundry wing, and a dry-house for the lumber are planned for. H. V. Deming will act as general manager and superintendent of the works. The manufactures will include the Wiggins patent clutch, wood split pulleys, sprocket wheels, iron pulleys, sleeve couplings, automatic scales and other devices.

Recent sales of the engineering department of the Pittsburgh Gage & Supply Company, Pittsburgh, Pa., include two 350 horse-power water tube boilers, with stokers and coal-conveying apparatus for the Montrose Pumping Plant, Allegheny City, Pa.; eight stokers for the Allegheny City lighting plant, a 1,000 horse-power Patterson-Berryman water heater for the Whipple Colliery Company, as well as a 135 horse-power Patterson-Berryman water heater for the Lake Erie Limestone Company.

The Baltimore Rolling Mill Company has been incorporated under the laws of Delaware, with a capital of $200,000, and has elected Harry Wehr president, Chas. G. Phillips vice-president and treasurer and J. R. Bailey secretary. The company has just purchased land, and a plant is to be established as early as possible. It is now busy planning for buildings and machinery. The product at the start is to be bar iron, and perhaps more finished products later. The company has opened an office in Room 604, Continental Trust Building, Baltimore.

The Hayden-Corbett Chain Company has been incorporated under the laws of New Jersey. The members include W. S. Hanna, J. D. Price, W. C. Orr, W. H. Andrews, John

W. Hayes, H. C. Godman, Louis Fieser, W. A. Hardesty, William McGraw and John T. Corbett, all of Columbus, O. The capital stock is $100,000. The company will own an improved chain-making machine which will simplify and cheapen the process. It is the intention to erect large buildings at Columbus at once and about 400 men will be employed when the plant is fully equipped as intended.

There is reported at Springfield, O., the incorporation of the Fairbanks Tool Company, with a $160,000 capital stock, by N. H. Fairbanks, M. L. Milligan, W. H. Sieverling, Pearl Young and Joseph Normand, with the purpose of merging the Springfield Foundry Company, the Fairbanks Machine Tool Company and the United States Tool Holder Company. N. H. Fairbanks has stated that the property of the Springfield Foundry Company and the Fairbanks Machine Tool Company will be sold to the Fairbanks Tool Company. It is the intention of the new company to erect a new brick building, 80x290 feet, two stories.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Patterns and models. 19 Thames st., N. Y.

We solicit inquiries for gear cutting. Benjamin Eastwood Co., Paterson, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Light machine & experimental work ; models made. S. Messerer, 15 Springf. av., Newark,N.J.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings ; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

For Rent—A three-story brick building, 50x50 feet, with 15 H.-P. boiler and engine ; inducements given by Board of Trade. Geo. E. Babcock, Fort Plain, N. Y.

Contract work wanted for small foundry and machine shop, used to doing good work only ; operated by owner, member A. S. M. E. Address Box 469, AMERICAN MACHINIST.

For Sale—$1,250 buys half interest in shop (Newark) manufacturing patent tool of more than ordinary merit ; 100 per cent. profit ; careful investigation invited. Box 571, A. M.

For Sale, at a Bargain—Right away and complete, machinery outfit with material, etc., for the manufacture of Metal Tree Labels ; an excellent business for a side line. Information and particulars, W. G. Young, Dayton, Ohio.

Purchaser for small manufacturing plant in Madison, Wis. ; lot, 100x180 feet ; machine shop, 32x68, two story, with line shaft and gasoline power ; foundry, 40x54, new modern equipment ; good location ; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—Purchaser to buy patent setting instrument, patented Mar. 18, 1902 ; an O. K. tool for machinists, and every machinist needs one ; designed for different purposes ; of interest to small tool manufacturers ; send at once for circular. Morris Chamberlain, Bartley, New Jersey.

Factory for Sale.—The land and building of the Branford Lock Works are offered for sale, comprising six acres of land and about 90,000 sq. ft. of floor area, together with boilers, engines, pumps, heating apparatus and electric light system ; Branford is seven miles east of New Haven, Conn., on the N. Y., N. H. & H. R. R. For particulars address the owner, The Yale & Towne Mfg. Co., 9 Murray st., New York.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine ; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R. ; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery ; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Foreman molder wants a situation ; long experience. Box 569, AMER. MACHINIST.

Experienced mechanical draftsman desires change of position. Box 574, AMER. MACH.

Situation wanted, technical mechanic, 37 ; 8 years in charge of factory ; correspondence solicited. Box 572, AMERICAN MACHINIST.

Corresponding clerk, now with steel castings company, excellent stenographer, desires position. Box 564, AMERICAN MACHINIST.

Draftsman who has had wide experience in shop and drafting room, wishes to change ; small salary if location is suitable. Box 570, AMERICAN MACHINIST.

An experienced die and tool maker will be open for a position July 1 ; would like to correspond with parties wanting such a man. Box 561, AMERICAN MACHINIST.

By man, 35, superintendent or master mechanic, or to take charge of an experiment requiring deep study ; reference present concern. Box 517, AMERICAN MACHINIST.

Tool designer wants position ; expert at designing tools, jigs, fixtures, etc., for reducing the cost of manufactured articles. Wm. H. Flood, 308 W. 123d st., New York City.

Mechanical engineer, graduate Stevens, several years' experience both mechanical and civil engineering, held important positions in Mexico, wants to change. Address Box 534, AMERICAN MACHINIST.

Chicago agency, superintendent or foreman ; extensive experience, steam or gas engine, hoisting or conveying machinery ; systematic hustler of men in any department. Box 578, AMERICAN MACHINIST.

A widely experienced superintendent and manager of machine works, expert in best shop practice and construction, of reliable executive ability and high-class references, seeks position with progressive and broad-minded concern. Address Y., 635 W. 61st st., Chicago.

Wanted—Outdoor work by mechanical draftsman, with 6 years' shop and 6 years' drafting-room experience on metal working, textile special, automatic, screw machinery, mill design, electric instruments, special tools ; American, 32 ; M. I. T. ; state particulars as to work and salary. Box 566, A. M.

Technical draftsman, expert toolmaker and designer, experienced in cash and car register, calculating machinery and building tools for any small and accurate article, wants change ; best references ; would be willing to start for $2,500 per year with reliable firm ; perfectly competent to handle men advantageously. Box 565, AMER. MACHINIST.

Mechanical engineer, technical graduate, chief draftsman and expert designer, desires change ; 8 years' experience as assistant M. E., M. E. and chief draftsman, in shop management, power plant installation, power transmission and design of light, heavy and automatic machinery ; best of references. Address M. E., care AMERICAN MACHINIST.

Wanted—Position as foreman or superintendent of factory doing first class work, and where first-class man will be appreciated ; experienced in designing tools, special machinery, electrical apparatus, sheet metal work and in handling help ; a wide-awake, progressive young man, energetic and capable in every branch of machine work. Address "American," Box 573, AMER. MACHINIST.

Machine shop foreman, at present employed, desires to make a change ; 12 years in present position handling from 70 to 80 men on very heavy and medium machine tool work ; would like position with firm building large marine or water-works engines ; capable of filling position of general foreman or shop superintendent ; first-class references if required. Address "Marine," care AM. MACH.

Help Wanted.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Wood pattern maker ; wages 30c. per hour, ten hours. Address Wm. E. Hill & Co., Kalamazoo, Mich.

Wanted—An expert electro-plater, also an experienced bicycle and novelty repairman. Box 577, AMERICAN MACHINIST.

Wanted—Two good, all-round patternmakers ; state experience and wages. Columbus Iron Works Co., Columbus, Ga.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—First-class metal and wood pattern makers ; state age, experience and wages expected. Box 563, AMERICAN MACHINIST.

Machinists, send for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—Four or five good fitters on machine tool work ; 9 hours per day ; no labor troubles. Address Pittsburgh Machine Tool Co., Allegheny, Pa.

Wanted—Brass finishers and lathe hands, experienced on valves and fittings. Address, giving all particulars and experience, Box 562, AMERICAN MACHINIST.

Wanted—First-class instrument maker on fine interchangeable work. Address, stating experience and pay expected, "New York," care AMERICAN MACHINIST.

Wanted—Lathe and planer hands for night work on heavy machine tool work ; good wages to good men. Apply to The Pond Machine Tool Co., Plainfield, N. J.

Wanted—Draftsmen ; first-class designers with experience on small machines and jig and fixture work. Call on or address The Taft-Peirce Mfg. Co., Woonsocket, R. I.

Foreman in machine shop manufacturing paper-making machinery and general jobbing. Address, stating age, experience, with whom, and wages expected. Box 568, AM. MACH.

Wanted—Experienced mechanical draftsman for position in New England States ; state age, education, experience and salary expected. Address Box 543, AMER. MACHINIST.

Wanted—First-class Gisholt turret lathe operator for modern machine shop in Chicago ; exceptionally good opportunity for right man. Send full information to Box 575, AMERICAN MACHINIST.

Wanted—Foreman for machine shop doing jobbing work, small and large ; in replying give full particulars as to age, experience and whether now employed, and where. Answer Box 576, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman, to take charge of a switch and frog shop, as foreman ; must have experience on steam and electric road work ; give age, experience and references. Address C. S., care AMER. MACH.

We are enlarging our works, and will shortly require an increased number of skilled mechanics ; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—First-class bench lathe hand, experienced on small duplicate brass work ; must be a hustler and willing to break in beginners ; steady job for the right party ; state experience and wages desired. Address G. M., care AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes ; give age, experience, salary expected and references. Box 237, AMER. MACH.

Wanted—Foreman to take charge of shop in which fine trains of gearing for electrical instruments are made in large quantities, also fine tool work ; must be first-class mechanic with experience in handling help. State experience and address your reply to "Foreman," P. O. Box 606, Newark, N. J.

Wanted—A good mechanical draftsman for designing dies, tools and attachments to be used on presses and machines for working sheet metal ; also experienced machinist to take charge of repair gang on general factory repair work ; old, well-established and growing concern in central Connecticut ; state age and experience in detail. Address Box 547, AMERICAN MACHINIST.

Wanted—By a corporation employing 100 men in New York State village of 5,000 inhabitants, a mechanical draftsman, about 35 years old, married and having at least 5 years' practical experience in drafting room, to act as assistant to head of department ; good pay to the man who wants permanent position and appreciates same ; American born preferred. Write, with full particulars, Box 567, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co..... 68
Acme Machinery Co..... 18
Adams Co., The..... 75
Akron Electric Mfg. Co..... 71
Albro-Clem Elevator Co..... 54
Allington & Curtis Mfg. Co... 61
Almond, T. R..... 78
American Fdry. & Mch. Co... 53
American Gas Furnace Co.... 15
American Mchry. Co....3d Cover
American Pulley Co..... 10
American Tool & Mach. Co... 54
American Tool Works Co.... 14
Armstrong Bros. Tool Co..... 60
Audel & Co., Theo..... 53
Automatic Machine Co..... 12
Automatic Machine Co..... 62
Automobile & Cycle Parts Co. 51

Baird & Co., Henry Carey.... 15
Baird Machinery Co., U..... 76
Baker Brothers.....58 and 81
Baldwin, Davidson & Wight.. 64
Balkwill Pattern Works..... 64
Ball Bearing Co..... 18
Barker & Chard Mch. Tool Co. 77
Barnes Co., B. F..... 15
Barnes & Co., W. F. & John.. 14
Barnett Co., G. & H...4th Cover
Baush Machine Tool Co..... 71
Bay State Stamping Co., The. 8
Beaman & Smith Co., The...
8 and 66
Belmer Machine Tool Co.... 52
Besly & Co., Chas. H.....
55 and 4th Cover
Bethlehem Fdry. & Mach. Co. 11
Bickford Drill & Tool Co..... 6
Bilgram, Hugo..... 67
Billings & Spencer Co..4th Cover
Binsse Machine Co.....18
Blanchard Mach. Co...18 and 75
Bliss Co., E. W..... 58
Boker & Co., Herman..... 64
Boston Gear Works..... 15
Bowler & Co., Geo. H..... 81
Bradford Machine Tool Co... 5
Bremer Machine & Tool Co... 53
Bridgeport Chain Co..... 72
Bristol Co.....4th Cover
Brown & Co., R. H..... 67
Brown & Sharpe Mfg. Co....
1 and 4th Cover
Brown Hoisting Mch. Co.... 72
Buffalo Forge Co.....4th Cover
Builders Iron Foundry..3d Cover
Bullard Machine Tool Co.... 16
Burt Mfg. Co..... 69
Butler A. G..... 62

Caldwell & Son Co., H. W.... 59
Carborundum Co., The..... 52
Card Mfg. Co., S. W..... 8
Carpenter Tap & Die Co., J. M. 8
C & C Electric Co..... 68
Champion Blower & Forge Co. 61
Chandler & Taylor Co..... 61
Charter Gas Engine Co..... 61
Chattanooga Machinery Co... 11
Chicago House Wrecking Co.. 77
Chicago Pneumatic Tool Co.. 75
Chicago Raw Hide Co..... 17
Chicago Ship Building Co.... 77
Christensen Engineering Co.. 71
Christman, A. B..... 52
Cincinnati Mach. Tool Co.... 73
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co..... 80
Cincinnati Shaper Co..... 18
Clark Auto. Telephone Switch
Board Co..... 53
Clark, Jr., & Co., Jas..... 81
Cleveland Crane & Car Co... 73

PAGE

Cleveland Gear Works..... 66
Cleveland Machine Screw Co.. 57
Cleveland Pneumatic Tool Co. 52
Cleveland Punch & Shear Wks.
Co..... 65
Cleveland Twist Drill Co....
4th Cover
Cleveland Wire Spring Co.... 61
Clough, R. M..... 66
Coes Wrench Co..... 10
Columbus Machine Co..... 61
Commercial Electric Co..... 70
Conant & Co., J. E..... 78
Consolidated Engine Stop Co. 61
Consolidated Schools..... 64
Cook Co., Asa S..... 66
Crane Co.....60 and 62
Crocker-Wheeler Co..... 69
Crosby Stm. Gage & Valve Co. 15
Cullen, Orlan Clyde..... 64
Curtis & Curtis Co., The..... 62
Cushman Chuck Co..... 66

Dallett & Co., Thomas H..... 72
Dawson Mchry. Co., J. H.... 77
Detrick & Harvey Machine Co. 60
Diamond Drill & Machine Co. 62
Diamond Machine Co...3d Cover
Diamond Saw & Stamping
Works..... 73
Dixon Crucible Co., Joseph... 56
Dreses Machine Tool Co..... 81
Dustin Co., Chas. E..... 76
Dwight Slate Machine Co.... 55

Errington Auto. Tap & Die Co. 67
Etna Mfg. Co..... 16
Evans Friction Cone Co..... 67
Excelsior Needle Co..... 80

Fairbanks Co., The..... 77
Faneuil Watch Tool Co..... 82
Fawcus Machine Co..... 17
Fay & Scott..... 75
Fellows Gear Shaper Co..... 60
Field, Chas. H..... 53
Foos Gas Engine Co..... 61
Franklin Portable Crane &
Hoist Co..... 72
Frick Co..... 61

Garvin Machine Co., The.... 67
Gay & Ward..... 59
General Elec. Co..... 70
Geometric Drill Co..... 66
Gisholt Machine Co..... 63
Gleason Tool Co.....4th Cover
Gobeille Pattern Works..... 18
Gorton Machine Co., Geo..... 62
Gould & Eberhardt..... 18
Graham Mfg. Co..... 17
Grant Gear Works..... 18
Grant Mfg. & Mach. Co..... 18
Grant Tool Co..... 63
Gray-Blaisdell Co..... 13
Gray & Prior Machine Co.... 55
Gray Co., G. A..... 18
Greenwald Co., I. & E..... 78
Gump & Co., A. W..... 77

Hall's Sons, Saml..... 77
Hammacher, Schlemmer & Co. 53
Hampden Corundum Wheel Co. 66
Harrington, Son & Co., Inc.,
Edw..... 80
Harris & Co., Sam'l..... 66
Hartford Steam Boiler Insp.
& Ins. Co.....66
Hart Mfg. Co..... 80
Hendey Machine Co..... 51
Henley & Co., N. W..... 53
Herron & Bury Mfg. Co..... 75
Hill, Clarke & Co...13, 77 & 78
Hilles & Jones Co..... 54
Hoefer Mfg. Co..... 8

PAGE

Hoggson & Pettis Mfg. Co... 66
Horsburgh & Scott....4th Cover
Horton & Son Co., E..... 66
Houghton & Co., E. F..... 57
Howard Iron Works..... 55
Hunt Co., C. W..... 72
Hunt Co., Robt..... 61
Huribut-Rogers Machine Co... 11

Ingersoll Milling Mach. Co... 60
Ingersoll-Sergeant Drill Co... 75
International Steel & Mchry.
Co..... 64
Iroquois Machine Co..... 63

Jacobson Machine & Mfg. Co. 79
Jantz & Leist Electric Co.... 68
Jeffrey Mfg. Co., The..... 77
Jenkins Brothers..... 60
Jones & Lamson Machine Co.. 18

Kelly Machine Co., R. A..... 53
Kempsmith Mfg. Co...77 and 78
Keuffel & Esser Co..... 58
Kilbourne & Jacobs Mfg. Co.. 52
Landis Tool Co..... 57
Le Blond Machine Tool Co.,
R. K.....4th Cover
Le Count, Wm. G..... 66
Leland & Faulconer Mfg. Co.. 54
Link-Belt Engineering Co.... 80
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co..... 16
Lorentz & Evarts..... 15
Lunkenheimer Co., The..... 60

McCabe, J. J.....17 and 76
McKenna & Bro., Jas. J..... 64
Maris Bros..... 72
Marshall & Huschart Mch. Co. 77
Merrell Mfg. Co..... 60
Merrill Bros..... 52
Merritt & Co..... 78
Mich. College of Mines..... 15
Mietz, August..... 61
Mitts & Merrill..... 80
Morse Twist Drill & Mach. Co. 17
Morse, Williams & Co..... 54
Mossberg & Granville Mfg. Co. 82

New Era Iron Works Co..... 61
New Haven Mfg. Co..... 8
New Process Raw Hide Co... 17
Newton Mach. Tool Wks., Inc. 11
Nicholson & Co., W. H..... 75
Nicholson File Co..... 51
Niles Tool Works Co..3, 76 & 77
Niles Tool Works Co. (Hamil-
ton)..... 2
Northampton Emery Wheel Co. 58
Northern Electric Mfg. Co... 70
Northern Engineering Works. 72
Norton Emery Wheel Co..... 71
Nuttall Co., R. D..... 82

Obermayer Co., The..... 64
Oesterlein Mach. Co..... 81
Olds Motor Works..... 61
Osborn Machinery Co..... 77
Oster Mfg. Co..... 8

Parker Co., Chas..... 62
Patriarche & Bell..... 64
Patterson, Gottfried & Hunter
Co., Ltd..... 59
Pawling & Harnischfeger..... 72
Pearson Machine Co..... 71
Phila. Pneumatic Tool Co.... 73
Pittsburgh Shear Knife & Mch.
Co..... 54
Poole & Son Co., Robert..... 71
Potter & Johnston Co..... 10
Pratt & Whitney Co.....
65 and 3d Cover
Pratt Chuck Co..... 67
Pratt Institute..... 15

PAGE

Prentiss Tool & Supply Co... 76
Prentiss Vise Co..... 55
Quint, A. D..... 54
Racine Machinery Co..... 62
Rand Drill Co..... 75
Reade Machinery Co..... 65
Reed Co., F. E..... 55
Reeves Pulley Co..... 73
Regal Gas Engine Co..... 61
Rivett Lock Co..... 82
Robbins & Myers Co., The... 68
Rogers, Boat, Gage & Drill
Works, John M..... 74
Roller Bearing & Equip. Co.. 18
Roth Bros. & Co..... 68

Safety Emery Wheel Co..... 55
Saunders' Sons, D..... 62
Sawyer Tool Mfg. Co..... 82
Schacht Mfg. Co..... 67
Schumacher & Boye..... 9
Schwerdtle Stamp Co..... 17
Sebastian Lathe Co..... 58
Sellers & Co., Inc., William., 18
Seneca Falls Mfg. Co...52 and 67
Shultz Belting Co..... 18
Sibley & Ware..... 64
Simonds Mfg. Co..... 78
Skinner Chuck Co..... 66
Slocomb & Co., J. T..... 62
Sprague Electric Co..... 68
Springfield Gas Engine Co... 61
Standard Connecting Rod Co. 60
Standard Tool Co., The..... 73
Starrett Co., L. S..... 11
Steptoe & Co., John..... 18
Stevens & Co., Milo B..... 64
Stover Engine Works..... 61
Stowell, J. A..... 60
Struthers, Wells & Co..... 61
Stuart's Foundry & Mach. Co.
4th Cover

Tabor Mfg. Co..... 56
Thompson, Hugh L..... 10
Toledo Machine & Tool Co... 58
Toomey, Frank..... 77
Triumph Electric Co..... 68
Trump Brothers Machine Co.. 66

Underwood & Co., H. B..... 62
Uniform Steel Co..... 10
U. S. Metallic Packing Co.... 53
U. S. Steel Co..... 64

Vanderbeek Tool Works..... 62
Veeder Mfg. Co..... 62

Wallace, D..... 68
Waltham Watch Tool Co..... 71
Ward & Son, Edgar T..... 64
Warner & Swasey Co..... 58
Watson-Stillman Co..... 16
Weber Gas & Gasoline Eng. Co. 61
Westcott Chuck Co..... 66
Western Electric Co..... 71
West Haven Mfg. Co..4th Cover
Westinghouse Elec. & Mfg. Co. 69
Wheaton Machine Co..... 75
Whitcomb Mfg. Co..... 63
Whiting Foundry Equip. Co.. 72
Whitney Mfg. Co..... 59
Whiton Machine Co., D. E.... 66
Wiley & Russell Mfg. Co..... 62
Williams & Co., J. H..... 68
Windsor Machine Co..... 73
Winkley Co., The..... 75
Wire Belt Lace Co..... 52
Wold & Co., Torris..... 58
Woodward & Powell Planer Co. 54
Worcester Mach. Screw Co.. 62
Wormer Machinery Co., C. C. 76
Wyke & Co., J..... 15
Wyman & Gordon.....4th Cover

Yale & Towne Mfg. Co..... 72

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Ball Bearings

See Roller Bearings.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.

Belt Fastener

Wire Belt Lace Co., Rochester, N. Y.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry Co., Cleveland, O.

Blocks and Tackles

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Boiler Insurance

Hartford Steam Boiler Ins. & Insp. Co., Hartford, Conn.

Boilers

Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Boring and Turning Mills

Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Books, Mechanical
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Henley & Co., N. W., New York.

Bottle Holder, Draftsman's
Christman, A. B., Cleveland, O.

Carborundum
See Grinding.

Castings, Aluminum
McKenna & Bro., Jas. J., New York.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
McKenna & Bro., Jas. J., New York.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.
U. S. Steel Co., Everett, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Fanuell Watch Tool Co., Boston, Mass.
Jacobson Mach. & Mfg. Co., Warren, Pa.
New Haven Mfg. Co,. New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray & Blaisdell, Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelhia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
North Penn Iron Co., Phila., Pa.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Toledo Mach. & Tool Co., Toledo, Ohio.
Torris, Wold & Co., Chicago, Ill.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Radial
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collector
Allington & Curtis Mgf. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Calculator
Wallace, D., Brooklyn, N. Y.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, J. G., St. Louis, Mo.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburgh Shear Knife & Mch. Co., Pittsburgh, Pa.

Handles, Machine Tool
Scnacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F., & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Lathes—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.
Racine Mchry. Co., Racine, Wis.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mgf. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Toledo Mach. & Tool Co., Toledo, Ohio.
Torris, Wold & Co., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua,

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves Pop
Crane Co., Chicago, Ill.
Crosby tSeam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
Pratt Institute, Brooklyn, N. Y.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegeny, Pa.
Chicago House Wrecking Co., Chicago, Ill.
Dawson, John H., Chicago, Ill.
Dustin Co., Chas. E., New York.
Fairbanks Co., Philadelphia, Pa.
Gump & Co., A. W., Dayton, O.
Garvin Mch. Co., New York.
Hall's Sons, Sam'l, New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Osborn Mchry. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New Haven.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.
Reade Mchry. Co., Cleveland, O.
Toledo Mach. & Tool Co., Toledo, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Herman Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Herman Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros Tool Co., Chicago, Ill.

Tools
See Machinists' Small Tools.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mch. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

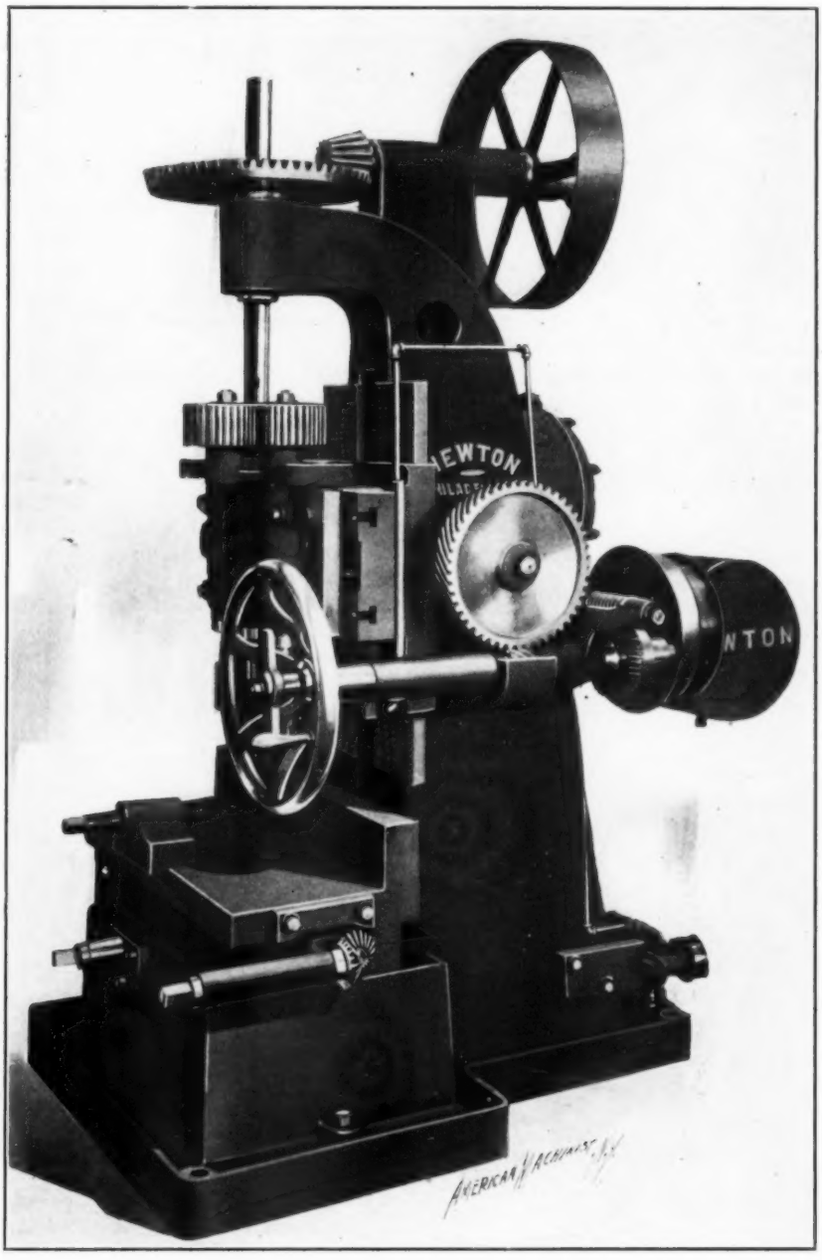
Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Three-Spindle Rail Drilling Machine.

The accompanying illustration shows a special three-spindle drilling machine for drilling the six holes in the ends of girder rails for street railways. As the two rows of holes are too close together to be drilled at once, the machine is arranged for drilling the three holes of one row and the table is given a traverse to and from the column to reach the second row of holes.



THREE-SPINDLE RAIL DRILLING MACHINE.

The table is also adjustable laterally. The three spindles are adjustable in center distance from 3½ to 9 inches. The head is counterbalanced, and is fed by rack and worm gear feed with hand return. An oil pump will be observed at the right, and an oil pan returns the lubricant to it. The machine is the product of the Newton Machine Tool Works, of Philadelphia.

Getting Fair Play for Modern Steel.*

It hardly seemed necessary to explain to an engineer or anyone authorized to purchase and therefore presumably competent that if he wanted material to sustain severe usage in the nature of alternating stresses, to which all forgings are subjected, he should select a material possessing a very high elastic limit. And yet it was not unusual to find that those very people preferred to use wrought iron for their engine cross-head and crank-pins and shafts in preference to steel, because, as they said, "steel being crystalline is brittle and snaps off suddenly under such service as that under consideration; while iron having fiber is tougher and yields before breaking." Most of these men knew better, but had not given the subject sufficient thought or they would have perceived that their statements were not consistent. They said that the steel connecting rods they had tried had broken off short without any warning, while rods made of wrought iron had simply bent up and after having been straightened out were replaced as good as new.

These people did not stop to think that a steel rod that broke off short had done so at its ultimate strength or under a stress of from 80,000 to 90,000 pounds per square inch, whereas the iron rod which had doubled up had done so at its yield point of 25,000 to 30,000 pounds per square inch. In other words, their engines with wrought iron rods were failing all over the country under loads about one-third what they were standing up to when supplied with steel rods, and they were blaming the steel for helping them out of their troubles.

Then again they complained that steel shafts and crank-pins heated up while wrought iron ran cool. When it was shown them that laboratory experiments showed that the coefficient of friction of these metals was the same and that any difference in heating was caused by local circumstances, such as poor lubrication, excessive pressure, etc., they said they did not care for laboratory experiments. They had an engine in one place with a steel shaft that never would run cool, while another with a wrought iron shaft had never given any trouble and they were passing judgment on their own experience. Persistent exposure of these fallacies gradually brought about a change in sentiment.

It took a long time to persuade people who had seen broken forgings which showed a coarse crystalline section that the metal had not crystallized from shock or vibration in service, but had been forged in such a manner that the crystalline condition of the ingot from which the forging had been made had not been changed by the forging process or by subsequent heat treatment. And these are the people even now who consider themselves conservative, who would rather have their forgings made of a mild steel which is weak than a higher carbon steel which is strong, simply because the old ideas are not yet eradicated from their minds.

* H. F. J. Porter, before the Engine Builders' Association.

The Gentle Art of Contracting.

A Russian correspondent sends us an amusing tale about an American contractor in Russia. A few years ago the contractor in question cast eyes upon a certain contract on the Nikolævsky Railway. Not being able to obtain it by fair means, he went on a beautiful cloudless day to the personage who had control of the contract, taking with him a huge umbrella. In reply to the personage's remark that there was no danger of rain, the Yankee contractor offered to bet 100,000 rubles that it would be pouring within half an hour. The offer was accepted. At the end of the half hour the sky was still cloudless, the sun was

shining even more beautifully. The contractor therefore lost his bet—but he got the contract. Our correspondent adds that personally speaking he believes that the thing is usually done in a much simpler manner. Of course, such things are happily confined to Russia. It is a backward country.—*Commercial Intelligence.*

Some Points in Shop Practice From the Cincinnati Milling Machine Company.

Several times in the past these columns have contained notes regarding various methods followed at the works of the Cincinnati Milling Machine Company. Those works are nothing less than a mine from which to extract material of this kind and the present article shows a few of the many interesting things seen there during a recent visit.

This concern takes its own medicine in large doses and fast work, obtained through their all gear feed, is everywhere in evidence. Fig. 1 shows a simple operation in cast iron, in which the cut lengthwise of the cutter measures 8¼ inches, the depth 3-32 to 5-32 inch from the scale surface, the speed of the cutter 40 feet per minute and the rate of feed 8½ inches a minute.

Another case of fast milling is seen in making the T-slots in the milling machine platens, of which the cross-section is shown in Fig. 2. The body of the slot is first stocked out to the dotted line, the bottom of the T being then done on the milling machine. The rate of feed for this second job is 6½ inches per minute. A still more remarkable case, because of its small size, is shown in Fig. 3. The T-slot here shown is the one on the side of the platen to which the feed tripping dogs are attached. In this case the slot is stocked out by a four-fluted end mill at a feed of 6½ inches per minute and the T head is then done at a feed of 6⅜ inches per minute. These rates of feed are made possible by a strong air blast which clears out the chips. Without the air blast such feeds are impossible as the cutters clog and break at once.

This use of an air blast naturally introduces a description of a new use for compressed air which is universal in these works. The shop is piped for air in all departments and branches are led to all tools and to the vise benches. To the end of each branch is attached a short piece of small hose having a nozzle with a spring closed valve which is easily opened by slight pressure of the thumb. The blast is used for clearing out centers in lathe work, for blowing chips out of holes in work on the drill press and elsewhere, for clearing milling cutters and work of chips, for clearing benches of dirt and for a thousand and one other things. The repeated *p-sh p-sh* of the air which one hears in the shop attests the use made of the arrangement, which Mr. Holz declares is the most useful application of compressed air in the works.

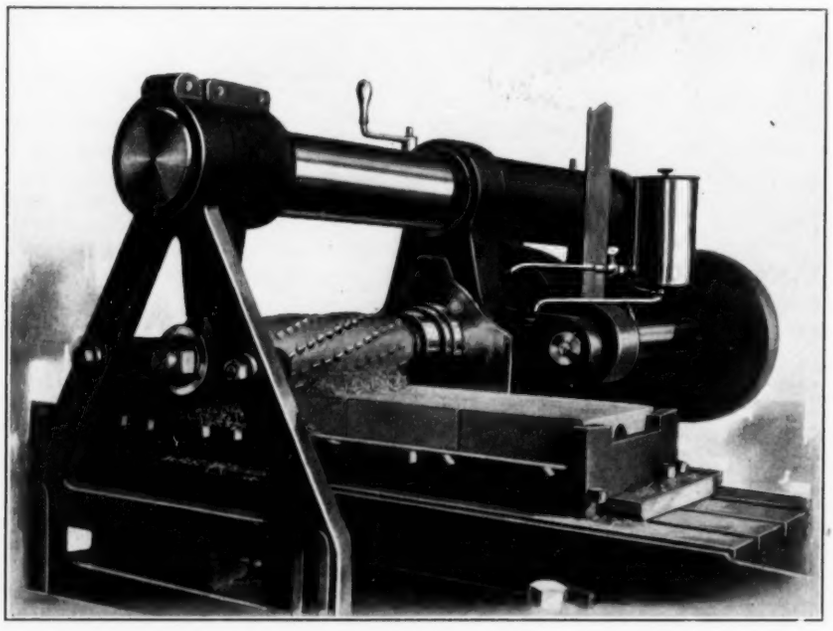


FIG. 1. A CASE OF FAST MILLING.

Another piece of fast milling is shown in Fig. 4 and consists of cutting dovetailed slots in the periphery of cast-steel cylinders which are about 14 inches in diameter by 9⅝ inches long. The slots are 2⅞ inches wide at the bottom, 1⅝ inches wide at the top and 1⅛ inches deep. They were first stocked out by the cutter shown on the table of the machine. At one passage of this cutter a slot 1⅝ inches wide and 1⅛ inches deep was cut into the solid metal, the peripheral speed of the cutter being 36 feet and the rate of the feed 1 5-64 inches per minute. The slots were then finished to size with the angular cutter which is in place in the spindle, the feed being 1⅞ inches per minute. The first operation is considered the more remarkable because of the quantity of metal removed and the nature of the cut, which necessitated the cutter being completely buried in the metal, each tooth cutting through an arc of 180 degrees. The cutter for this cut was 1⅝ inches in diameter with six flutes, which are nicked alternately, as shown. The direction of the spiral of these flutes will be seen to be the reverse of the usual practice, the spirals being *right hand* with an angle of approximately 20 degrees. This company is fixed in its conviction that for end mill cutters which are to be buried in the metal the usual direction of the spirals is wrong. Their idea is that the spirals should be right hand, like those in a twist drill, and for the same reason—to draw the chips out of the cut instead of forcing them into it, as a left-hand spiral would do. In point of fact, with the job described, a cutter with left-hand spirals was first tried and it broke before burying itself because of the accumulation of chips.

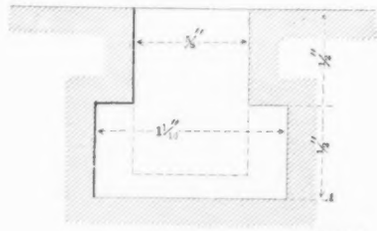


FIG. 2

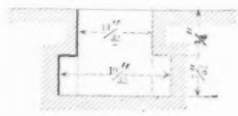


FIG. 3

ADDITIONAL CASES OF FAST MILLING.

The angular cutter is of 2⅞ inches diameter and has four flutes for its entire length and four more for half its length, the flutes being nicked alternately, as with the first cutter.

An essential factor in this job was a strong jet of oil forcibly delivered to the cutters, which, like the air blast in the cast-iron job, cleared away the chips. The machine on which the work was done was a No. 4 plain Cincinnati with the all-gear feed. A powerful feed is considered essential, as, the movement being vertical, the feed gear had to lift the work and the table, in addition to feeding the work against the cutter. As the work alone weighed 270 pounds, it formed no slight load on the feed gearing. The cylinder had eight slots 9⅝ inches long and the work was done in 5¾ hours, which in-

cluded the time consumed in setting the work and in changing the cutters.

Like most machine-tool builders, this company has a good deal of deep drilling to do in steel spindles, and, after trying the various styles of drills for this class of work, they have settled down to the use of a plain flat drill, which is operated in a lathe having a special power feed attached to the spindle of the tailstock and a guide rest attached to the carriage, as shown in Fig. 5. The drill, which is shown in Fig. 6, is a simple flat drill well made and ground for clearance with a very thin point and with a brass oil tube soldered to one side. The piece of work shown in Fig. 5 is a milling machine spindle of hard steel, 35¾ inches long. The hole being drilled is 13-16 inch in diameter, the speed is 225 revolutions and the feed 17-32 inch per minute.

While the use of other forms of drill for this class of work is almost universal, we know of two other concerns that have come back to substantially the tool here shown. We are satisfied that in general the work is not run fast enough, the full benefit due to the cooling effect of the oil not being taken advantage of. High speed and a light chip are undoubtedly the secret of success in this work. The speed given above will show what is entirely possible, though it is probably not much less than double the average. We know other cases in which a speed of 150 revolutions per minute is used for holes up to 1¼ inches in diameter.

Fig. 7 shows a method of doing at one handling a piece of work on an automatic turret lathe in which the hole and the outside must be true with one another. The outside is turned with a forming tool and the inside is done essentially as it would be done in a common lathe. First is a short, stiff starting drill, and then an oil tube twist drill. Following this comes a small boring tool which trues the hole and leaves it the proper size for the reamer, and finally comes the reamer which is mounted in a loose socket. Four turret holes are required for making the hole—or five, if the end stop be counted—but there is still one hole to spare. The machine shown will be recognized as a Cleveland.

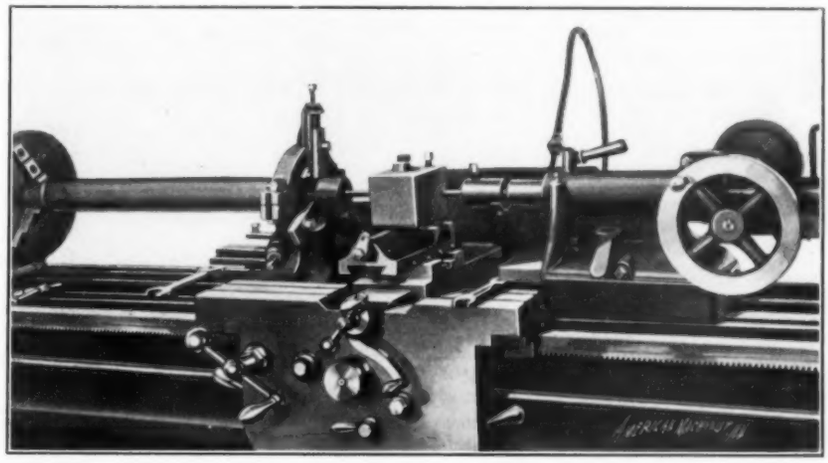


FIG. 5. DRILLING A SPINDLE.

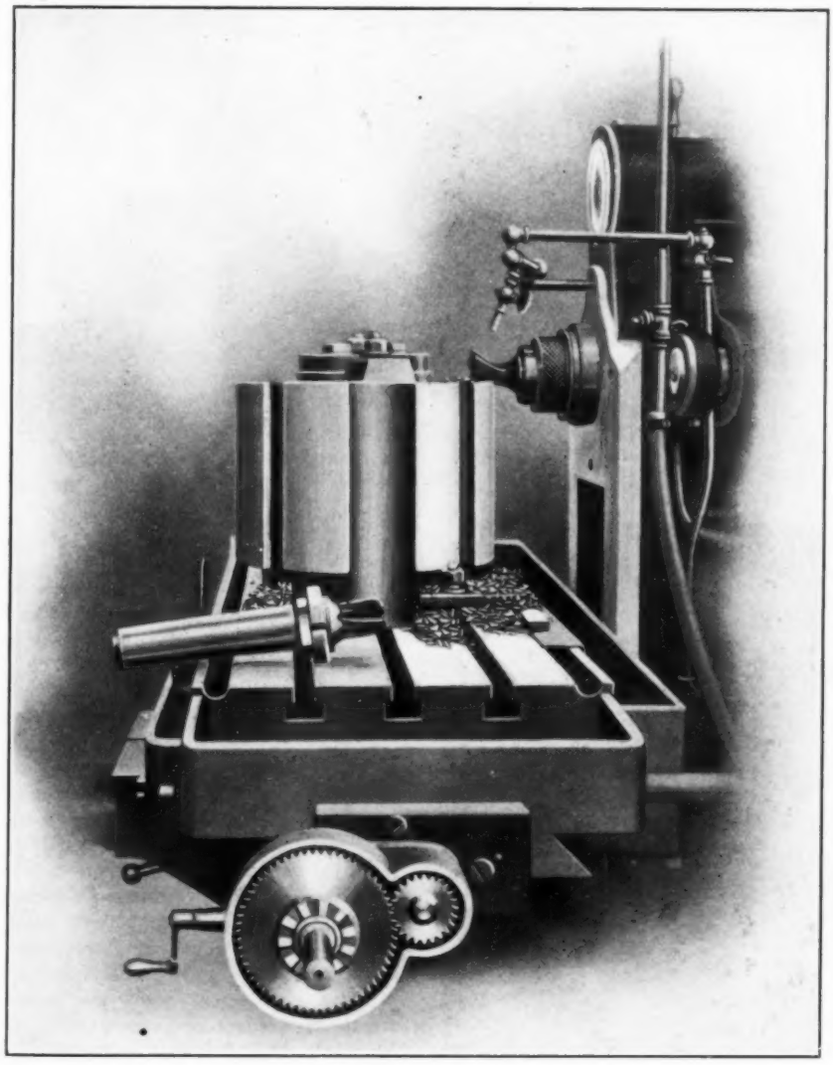


FIG. 4. ANOTHER CASE OF FAST MILLING.

For testing purposes large use is made in these works of the dial indicators made by the American Watch Tool Company. They are as accurate as micrometers in the readings and do not involve adjusting to contact, as do micrometers, but take their position and may be read instantly when applied to a surface. Moreover, the contact is by a delicate interior spring and the personal error due to varying the pressure of contact which is possible with micrometers is eliminated with this instrument. This is of particular importance in cases where, as in Fig. 8, the indicator is swung from a comparatively slender radius bar or where, as in Fig. 9, it is supported by a surface gage. In the latter case especially, it would be easy to obtain defective readings with a micrometer and, in fact, difficult to obtain good ones, because of the spring of the surface gage from the pressure of the screw.

Fig. 8 shows the method of testing the squareness of the table with the spindle and explains itself. The radius bar is 18 inches long, making the test of a good deal of delicacy. The side of the table is planed dead parallel with the slots, making it immaterial whether the test is applied as shown or to a strip in one of the slots.

Fig. 9 shows a very interesting test for

determining the parallelism between the proof staff and the table. Bolted to the table is a pair of carefully made adjustable jaws of which several are provided. The upper jaw is jointed to the lower at one end and has an adjusting screw at the other. The upper jaw is adjusted to the staff by the screw and the use of tissue paper, the only use of the indicator in this case being to insure that the staff is not sprung by the contact with the jaw. With the jaws adjusted, the table with its jaws is taken back to the planer and is packed up with paper until the indicator mounted on a surface gage shows the top surface of the upper jaw to be parallel with the planer platen. The table is then of necessity located in the planer as it was in its milling machine and, a light cut being taken over it, the surface is obviously brought to parallelism with the proof staff.

Fig. 10 shows another interesting test, the object of which is to determine if the center of the central slot is vertically in line with the center of the trunnion on which the table swings and the center of the main spindle—the trunnion and spindle center lines having been previously adjusted to intersect. The slot as first made is a little narrow to permit the shifting of the center when it is widened to its full width, should this test show such shifting to be necessary. The table is first adjusted to bring the slot parallel with the proof staff by taking readings with the indicator at the two ends of the staff. The support of the indicator has a tongue entering, but not filling, the central slot. With this tongue pressed against one side of the slot the reading is taken and then indicator and support are reversed to the opposite side of the staff, the tongue being pressed against the opposite side of the slot and a reading being again taken. If the slot is central with the staff the two readings will be alike, but if the slot is out they will differ, the error in the position of the slot being half the difference in the readings. A record of the readings is taken and the table is sent back to the planer. The slots were, in the first instance, planed parallel with the edge of the table and are again brought truly in line with the planer platen by strapping the milling machine table against a parallel strip bolted to the planer platen. The planer parting tool *a*, Fig. 11, is adjustable through a small range, as shown, to maintain standard width. An indicator *b* mounted in a manner similar to that shown in Fig. 10, is applied to the work and the planer tool, as indicated in Fig. 11, and the tool is adjusted on the planer cross rail until the indicator, when applied to the two sides of the tool, repeats the readings obtained in Fig. 10. The center of the tool is obviously then located with reference to the slot, as was the center of the proof staff in Fig. 10, and when the final cut is taken from the slot its center is shifted to its true position.

In the past serious difficulties have been found at these works in making cutters, collars and nuts for milling machine arbors truly square and parallel and the remaining illustrations show the methods employed to overcome these difficulties. Mr. Holz states that he found it was quite impossible to secure truth in the collars when they were made in a common lathe with a live headstock spindle, and that so long as they were made in such a lathe it was found necessary to correct them by hand scraping. He attributes this lack

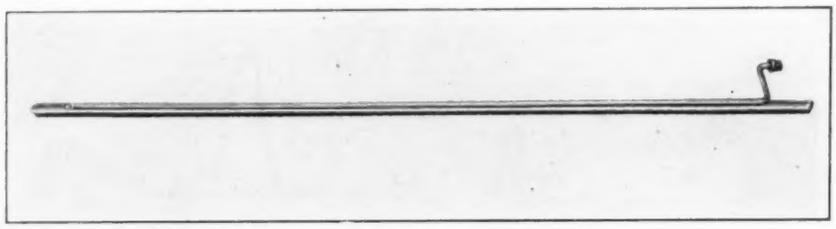


FIG. 6. THE DRILL USED IN FIG. 5.

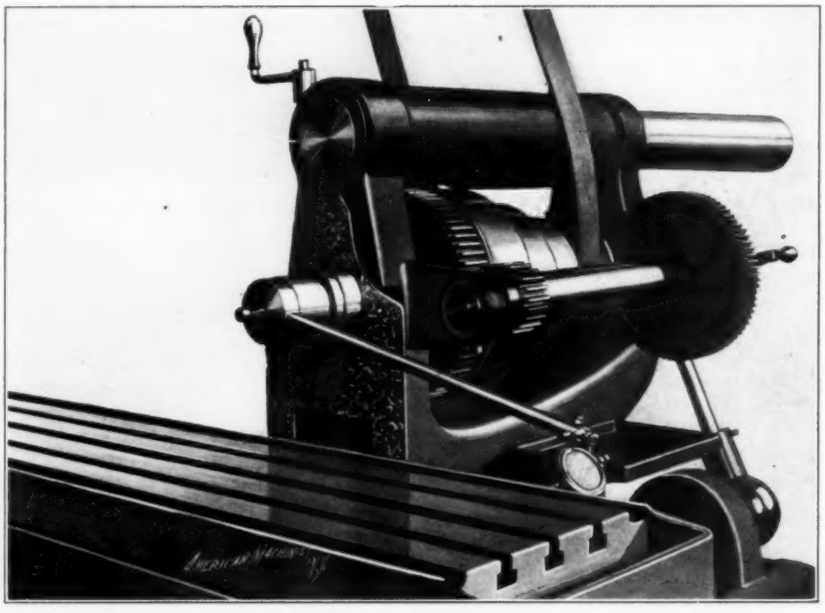


FIG. 8. TESTING THE SQUARENESS OF PLATEN AND SPINDLE.

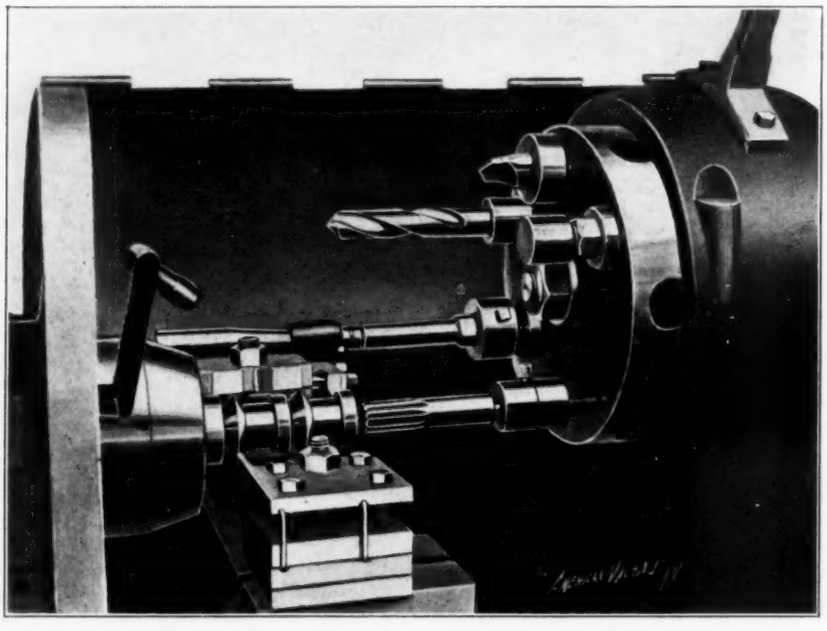


FIG. 7. TRUE BORING IN AN AUTOMATIC TURRET LATHE.

of truth in the collars to a lack of absolute truth in the lathe spindle step. Any lack of truth in this step will cause a slight end traverse in the spindle which appears in the work by a lack of squareness of the ends. He therefore had a special dead center lathe made for this work, which is shown in Fig. 12. The headstock is similar to those used on grinding machines, its center being dead and glass hard. The mandrel used is of the pin type, which was fully described in our issue No. 28, Vol. 19, and which is shown separately in Fig. 13. These mandrels can be made a fit in the work and dead parallel, the work being held by the binding effect of the small wire which is drawn by the twisting of the work to the narrow edge of the groove in the mandrel. This pattern of mandrel is found to be very useful for light work, though it is not used for heavy work. The mandrel being dead parallel, there is no cocking of the work and no distortion due to the drive being at the large end. The centers of the mandrel are lapped to the lathe centers, the whole outfit being of refined accuracy. With such an outfit the collars as they come from the lathe are found to be true and to require no hand work whatever.

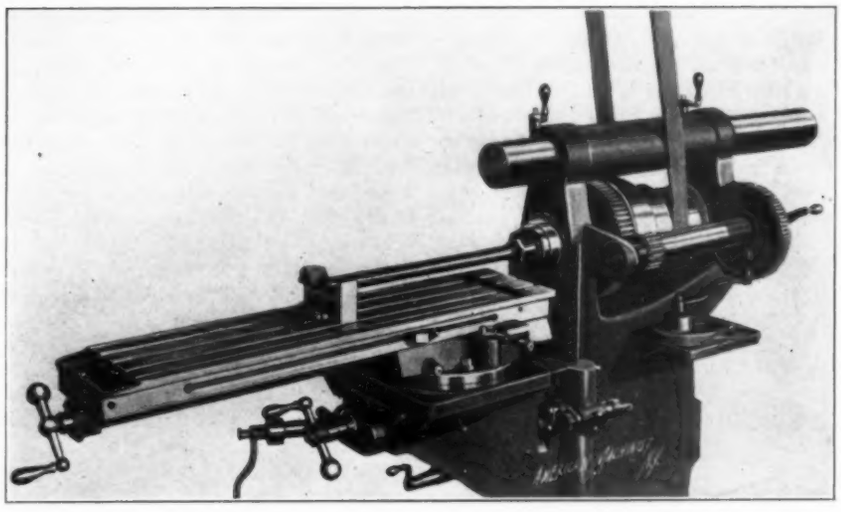


FIG. 10. TESTING ALINEMENT OF CENTRAL SLOT WITH SPINDLE AND TABLE TRUNNION.

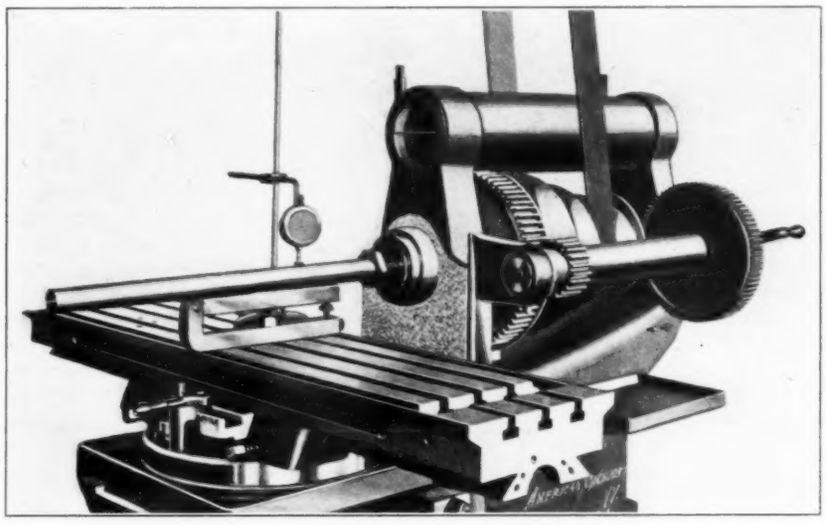


FIG. 9. TESTING PARALLELISM OF PLATEN AND SPINDLE.

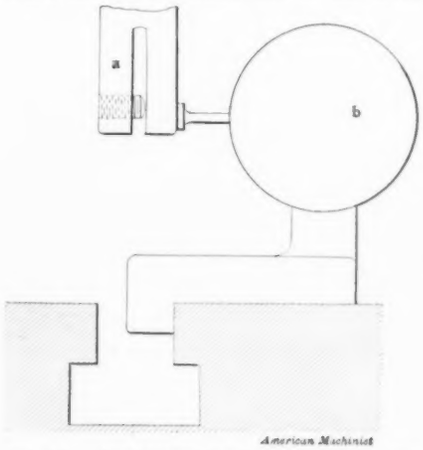


FIG. 11. ADJUSTING THE PLANER TOOL TO CORRECT THE POSITION OF THE SLOT.

The grinding of the sides of the cutters is shown in Fig. 14. The mandrel is taper with a split bush ground externally to a true fit in the hole in the cutter, which has been ground before the operation shown in Fig. 14, which will be recognized as showing the company's cutter grinder. Both centers of this machine are dead and the grinding is done with a dished wheel. The second side is ground without removing the cutter from the mandrel, work and mandrel being reversed bodily in the machine.

The facing of the arbor nuts is shown in Fig. 15. The making of a nut with its face truly square with the thread is well known to be an operation of a good deal of difficulty, and the method shown in this illustration will be of corresponding interest. These nuts are bought by the company, the size of the threads being required to be within specified limits and these limits are such that with three nut mandrels

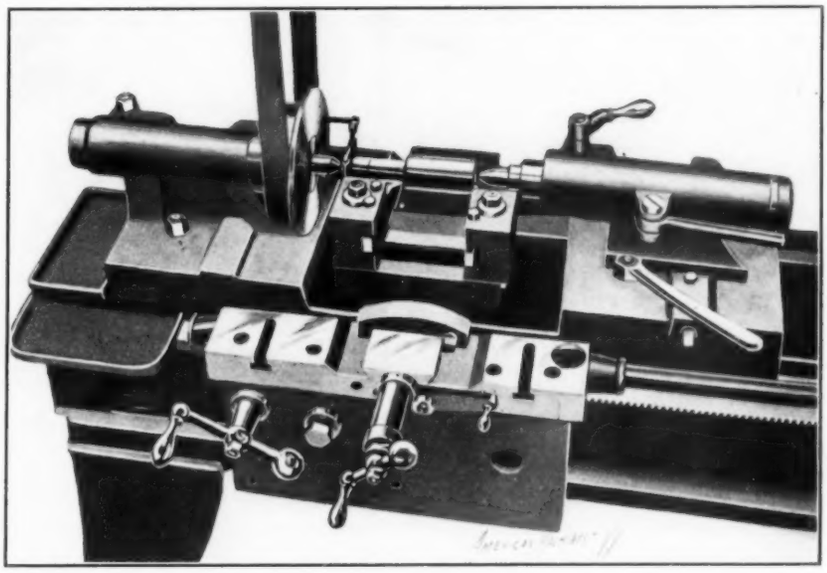


FIG. 12. SPECIAL DEAD CENTER LATHE FOR FACING ARBOR COLLARS.

—one of the superior limit, one of the inferior limit and one half way between—a mandrel can always be found on which a nut will go snugly with sufficient force to resist turning under the action of the emery wheel. A mandrel being found on which a given nut will thus go, the nut is placed in the machine and its face is ground with a dished wheel similar to the

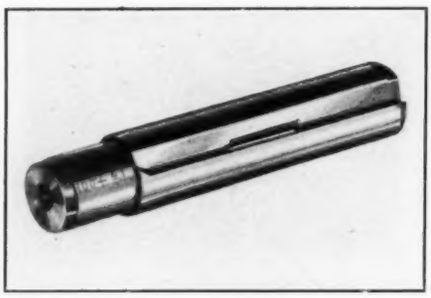


FIG. 13. PARALLEL PIN MANDREL.

one used for grinding the face of the cutter. It will be observed that there is no collar against which the nut is screwed and which would cock the nut unless its rear side were square, which it is not. The nut is squared absolutely by the fit of the threads, and when ground the face is necessarily square with the threads.

Fig. 16 is the proof of the pudding. An arbor is shown with a string of collars which are firmly clamped by the nut at the end. The whole is mounted in a pair of bench centers with an indicator. Were any one of the collars or the nut out of truth the tightening of the nut would spring the arbor and this would be shown by the movement of the indicator pointer when the arbor is revolved by the fingers. The writer saw three such arbors tested and the worst of the lot gave a movement to the indicator of one thousandth. Both the others showed a movement of about a quarter of a thousandth and, of course, the movement produced is twice the amount of the distortion.

Echoes From the Oil Country.

MEN IN THE SHOPS AND HOW TO GET THEM THERE.

"I don't know anything about it; never heard of such a thing; was there and didn't see it, therefore it isn't." One unfortunate correspondent never saw lightning or heard thunder in a snowstorm. I can readily believe him, as, since writing of the one such storm strongest in my memory, we had one here in the middle of the day and the next day I found lots of people that had never seen or heard of such a thing. Fortunately, I found some people that had seen it. I doubt not there are some among the readers of this paper who never saw the Aurora Borealis or shooting stars, or a lunar rainbow, or sun dogs, or a will-o'-the-wisp (except in the stock market), or St. Elmo's fire, yet they are all among the collection in my memory's cabinet.

Some people are so taken up and engrossed with the great things of the world that they could not be expected to give their attention to such trifles, while some apparently never see much of anything for themselves, believe only what they find written in the books and would hold up both hands in horror if anyone suggested that the books did not always agree with easily observed facts.

In mechanical matters it frequently happens that results are produced by numerous causes working together, some modifying and some magnifying others. Some of these causes may be very apparent, while others may be obscure even to the point of eluding any but the closest observer.

The ones clearly seen may be insufficient to produce results alone, but receive all the credit for it from the operator. The learned man may deny that the result is produced in the way described, because his knowledge of the action of the known cause shows it could not produce the result. In that case both the learned and the practical man may each have a poor opinion of the other.

To illustrate this point: I once knew of a gas engine being sent out into a new neighborhood. The parties who received it were entirely ignorant of gas-engine construction or manipulation and did not succeed in starting it. In the neighborhood was a gas engine of a different construction that was run by a man who posed in the place as an expert. According to his statements, which I have no reason to doubt, he had given gas engines particular attention while at Cornell, and was well qualified to speak with authority concerning them.

This man was sent for, came over, and, finding something he knew nothing about from his books or former studies, promptly and emphatically "sat down on it," so to speak. He said that an engine made in that way could not be run successfully if at all, which he very much doubted.

In tearing the engine apart, presumably to try to find out how it should run, the piston head was pulled out. This head was cut away on one side so as to give opening for the port which it would otherwise overlap. This he called the owner's attention to as having been sent out with a piece broken out, and the owner so reported to the maker. Notwithstanding his learning, this man did not know the natural looks of a casting when he saw it. For this he was not to blame, but he certainly was to blame for presuming to pass judgment on matters of which he was so entirely ignorant.

He would have been likely to have resented having the mechanic who built that engine condemning his education and classing him as an ignoramus because he did not know all about the casting; yet the mechanic would have had the most reason for his opinion, as the engine started and ran without any trouble as soon as a man that knew how to handle it got there, and the men that had it could see at once how to do it. A few minutes' showing and a little practice was all they needed.

If any man with an education, the highest that books and teachers can give, imagines that mechanics are without education because they lack his kind, let him go into some workshop and try to do some of the things he sees being done. He need not try the ones that seem the most intricate: just a simple weld in a blacksmith shop, or drawing a pattern in a foundry, or soldering a joint in a tinshop, or hanging a door in a new house, and the chances are that he will look at the mechanic in a different light by the time he has done a job that he feels like letting others see.

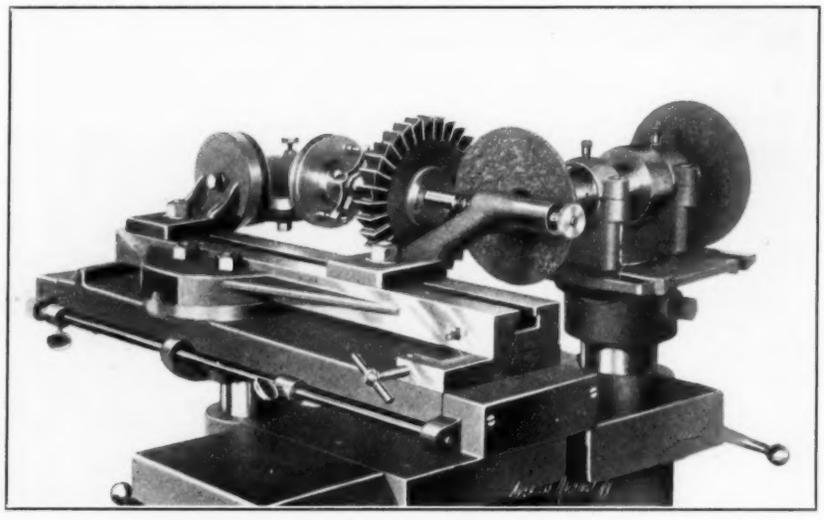


FIG. 14. GRINDING THE CENTRAL BOSS OF CUTTERS.

I don't want anyone to think that many educated men need to try the experiment to give them a proper idea as to the respect due the knowledge of the mechanic, but enough of them do to keep up a sort of

distrust toward themselves on the part of the mechanics.

In speaking thus I am referring to the educated man who is technically educated. I believe that the man with what is sometimes called a liberal education and which some practical fellow described as "a large fund of useless information not worth a dollar to anyone else" usually underrates

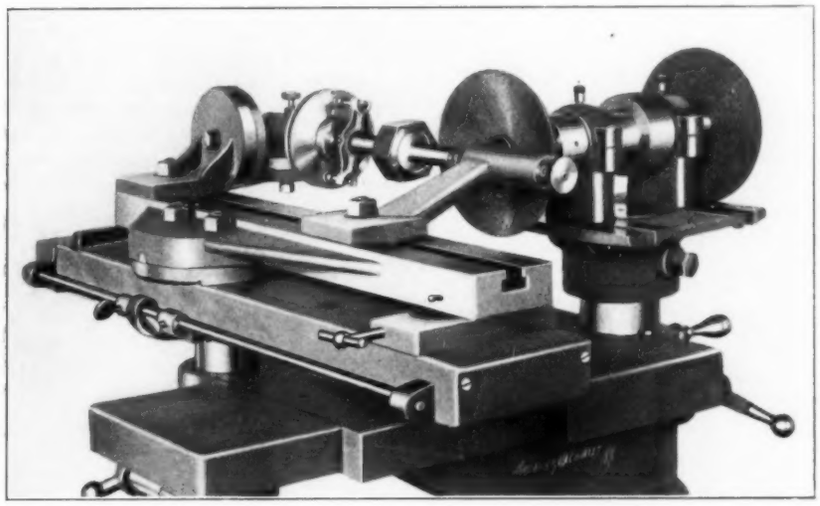


FIG. 15. GRINDING THE FACE OF ARBOR NUTS.

the quantity of information possess d by the mechanic and also underrates the effort necessary to acquire it, while often overrating these things in his own case.

When this is not so, the man of large education is generally well received in any shops he cares to connect himself with and to apply his learning to the things that are beyond the reach of the workman.

Many of us learn that it is a little risky to take issue with even a seemingly improbable statement with no better foundation for our disbelief than ignorance of the entire matter, because few of us know all about those things we know the most of, while the things we know anything at all about are few compared with everything. It used to be a matter of surprise to me to find out how many, many things there were in the world that the literature of the world never seemed to mention.

Stories being the vehicle that carries the first ideas of the world to children their ideas of the really important things are often largely influenced by early reading. Naturally enough, the story writer can tell only of the things that he knows or of the things that he sees. Very few of them apparently ever heard of a machine shop, fewer yet ever saw the inside of one close enough to get acquainted there. In a few instances some writer of fiction has put a mechanic in a story, but he evidently does it for want of either a villain or a make-weight.

I wish some man like Kipling, for instance, could serve an apprenticeship in the shops and then weave that part of his life into some of his stories, or that a second Longfellow could spend years with smut on his nose and then leave his experiences in immortal verse.

I had the pleasure, a few evenings ago, of listening to a talk by a molder before a church audience, on the art of molding. He also gave a few illustrations with sand, patterns, cores, etc. From the questions and remarks it was easy to see that many of the audience did not have the faintest conception of what a molder did or how he did it, except that he managed to get his face and clothes dirty and sometimes got burned; and this in a town where foundries are numerous and easy to visit.

If some novel had feelingly described the joy of a full day's work without a scab or blow or swell, or had painted the gloom and anguish caused by a bad drop just as the wind went on, or had shown what a restless night followed seeing the caricature turned out from the sand where a fine, useful article was expected, or had pictured to the reader the gloomy foreboding with which the foundry was approached the next morning after that miserable, inexcusable run out, what an interest it would arouse in the general public toward this same lot of men with the grime on their faces.

No doubt some of the ladies would be sending flowers in to the boys. Just imagine the effect in a foundry of a few bouquets such as Paderewski gets. Wouldn't the boys fix up before leaving the premises and wouldn't they step high as they went home, and wouldn't the boss molder have to have a bodyguard to keep away the young men who would be climbing over themselves and him trying to get a *situation* in the romantic poetical foundry?

This same reasoning applies to the machine shop. The condition is often bemoaned that not enough high-classed young men are attracted by the mechanical trades. Fear is expressed that the world's work will presently stop. Information is asked as to why this is so and many varied remedies are proposed.

The real reason is not far to seek. The greatest aim in the life of the young men is that they may please and possess the young ladies. To do this they will try to do or become anything. The young ladies' ideas are formed by the story writer, who, being a white-shirted, white-handed chap, writes of such because he knows them. Let the owners of machine shops get writers to describe the manly young fellow that can file the straightest, do the best lathe or planer work, etc., until that becomes the ideal in literature and that will be what the young ladies will want, and don't you think for a minute that the young men will not try to live up to the ideal. Let some one establish a training school for novelists who can describe the joys of making refractory metals obey the will of their master, or of making balky machines move on with precision and alacrity, or show the heroism necessary when one backs up against a post and has a shopmate dig a steel chip out of his eye. This is a condition seemingly overlooked by those who are worried about the future supply of mechanics. The way to get men into the foundries and shops is to get them to want to go there, and I think this plan carefully worked

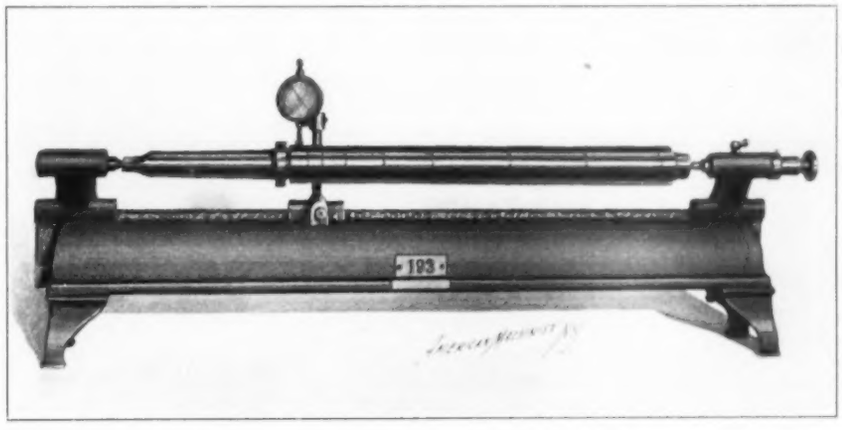


FIG. 16. PROVING THE TRUTH OF COLLARS AND NUT.

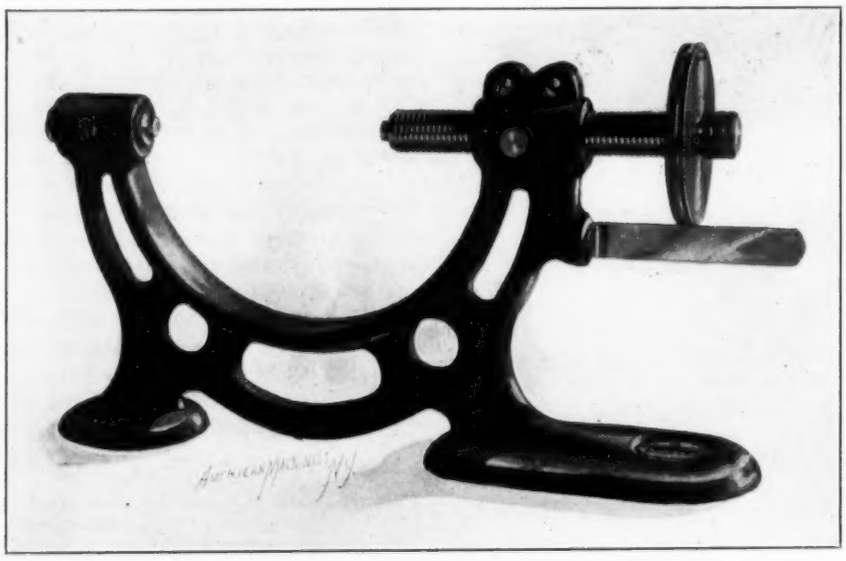
out will surely accomplish that. After the men are once acclimatized, other influences will make matters easier.

W. OSBORNE.

An English Micrometer Caliper.

The accompanying half-tone illustrates a micrometer caliper made by Humpage, Jacques & Pedersen, of Ashton Gate, Bristol, England.

The pitch of the screw is one-tenth of an inch, and the reading of the tenths is by the registering of the edge of the dial against the straight scale. The dial is of sufficient size to contain one hundred divisions, which arrangement is obviously very convenient in reading decimal dimensions. For reading binary fractions a table of decimal equivalents is furnished, although, of course, the equivalents for the more usual binary fractions soon become fixed in the memory. The knurled head coming through the side of the main nut is for clamping the screw in position after an adjustment has been made, and the screws above it are for taking up slack in case of wear.



AN ENGLISH MICROMETER CALIPER.

Distance pieces or end measures are not used, the calipers being supplied in several sizes, each of which measures through a definite range, the ranges for the different sizes being as follows: No. 1, from 0 to 1 inch; No. 2, from 1 to 3 inches; No. 3, from 3 to 6 inches; No. 4, from 6 to 9 inches; No. 5, from 9 to 12 inches.

The size shown in the illustration is the No. 3. The instrument is provided with feet to enable it to stand upright, which is considered more conducive to safety than a form which necessitates laying the instrument down, perhaps among a miscellaneous collection of rough tools. The frame is made of cast iron, the idea being that in case a caliper is dropped it is better to have it break outright than to bend and then remain in use, a permanently damaged and inaccurate instrument.

Richard Trevithick—An Unappreciated Inventor.

BY W. H. BOOTH.

If there be any virtue in centenaries the present year should claim the attention of engineers, on account of the fact that in 1802 Richard Trevithick took out his patent for a locomotive steam engine and ran it on the road at Camborne, in Cornwall, of which he was a native. This was the first steam carriage to carry a load, for it is recorded that Trevithick would invite people to get on board, and the machine would be as fully loaded with men as a Broadway car. Trevithick took the thing to London and exhibited it there on the site of what is now Euston station. Trevithick was a genius and pecuniarily unsuccessful and justice has not been done to him by biographers. Indeed Smiles' lives of the successful Stephensons is marred by a sneer at poor, unfortunate Trevithick, who built a successful smooth wheel locomotive years before Stephenson had ever seen one, and Trevithick's engine was only abandoned because it broke the tramplates of a very ricketty tramroad on which it ran.

I am reminded of Trevithick at this moment because I have just been engaged in testing certain steam engines in South Wales, on the site of the very works where Trevithick in 1803 built his first railroad locomotive, the year after the road locomotive above mentioned. He built the railway locomotive in the blacksmith shop of the Pen-y-darren iron works at the town of Merthyr-Tydfil, in Glamorganshire. In 1791 there was not any railroad in South Wales, but by 1811 as many as 150 miles had been laid connecting various mines and iron works, and to-day South Wales is a network of lines. The tramway to Pen-y-darren works was laid with the usual cast-iron plates on stone blocks. The blocks are still there in places. The old iron works, just at the edge of the town and at the foot of an enormous heap of waste, have been dismantled some years, and the site, which still shows the remains of ovens and flues in the side of the hill, is now occupied by an electric generating station, producing power to drive cars over the same road as was traveled early in 1804 by Trevithick's engine—the same engine a drawing of which is now in the museum at South Kensington. It is curious that this Merthyr line is almost the earliest of the South Wales electric lines, as it was actually the first steam-worked tramway.

In Trevithick's 1802 patent he provided for smooth wheels as giving sufficient adhesion for traction, but provided for rough wheels which might be sometimes necessary. The fact that he recognized that roughing might at times be required has been twisted into a claim that he was ignorant that smooth wheels would generally suffice, though he specifically stated they would so suffice in his 1802 specification. His Pen-y-darren engine actually drew a truck or trucks with a load of 10 tons of iron, but on its last journey it broke several of the tramplates and ran off the line, and was hauled home by horses. This engine had a cylinder 8 inches diameter, a flywheel and gearing, and its stroke was 4 feet 6 inches, the crosshead slides projecting forward with a return connecting rod, and the cylinder was enclosed in the boiler—to keep it warm, no doubt, for Trevithick understood the importance of dry steam. Though he made and ran the first practical locomotive, he cannot be called the absolute inventor of the locomotive. Wm. Symington made a working model of a steam carriage in 1786. Cugnot made some sort of a steam carriage in 1769 and a larger one in 1771, which is still preserved at the Conservatoire des Arts et Metiers, in Paris. This I believe I saw at Paris in 1900.

Watt, who did so much to discourage the use of high-pressure steam and called Trevithick a madman—Trevithick used steam of 50 pounds pressure where Watt was using 6 pounds—himself actually applied for a patent for a locomotive in 1784, but he talked about a wooden boiler and steam at atmospheric pressure and a surface condenser. He never attempted to make his engine, but his assistant, Murdoch, did make a small model with a spirit lamp boiler and a grasshopper motion in 1784. This is said to have been run on a dark night at Redruth, in Cornwall, and frightened the last man who ought so to have been frightened, to wit, the parson, who thought the thing was Satan. Nothing really substantial was done before Trevithick ran the Merthyr-Tydfil engine, which ran at five miles per hour on a very rough road. In 1811, after much persuasion, he sent one of his engines to Newcastle to be tried. It was not worked, but was seen by George Stephenson. In 1812 a double cylinder cog-wheel engine was put to work near Leeds by M. Mur-

ray, for Jno. Blenkinsop. William Hedley saw this engine and in 1813 built the old Wylam engine known as "Puffing Billy," now in the Museum at Kensington. This had four wheels, all driving. In 1815 he built one with eight wheels, all driving, and also cog driven like his previous engine. These engines had smooth wheels and ran by adhesion, but Hedley certainly did not discover the smooth wheel, as has been claimed. Stephenson in 1815 brought out what was practically a composition of Hedley's and Trevithick's engines.

Hedley's "Puffing Billy" had practically assumed the form of the present day engine despite its vertical cylinders. It was not until 1829, in the "Rocket," that the cylinders began to depart from the vertical position, and in 1830 Hackworth again placed his cylinders horizontal as Trevithick had done in 1802-4. By this time the locomotive had become known publicly and its success was assured.

Stephenson never claimed for himself that the locomotive was his invention. He rode to fortune on it because he struck it at the right time and under favorable circumstances. Trevithick never looked at it as his *magnum opus*. It was an incident only with him. We read of him chiefly as a steam engineer engaged in mine drainage. As such he went out to Peru and successfully drained the silver mines there. It was said that he was well paid for these eminent services and fêted as a king, but that on his return overland to Panama he lost all he had except the clothes he stood in and met Robert Stephenson, who had been out to South America also and who lent him the money to get home via New York. They traveled home together, and there is no evidence that Stephenson acted otherwise than as a "white man" toward Trevithick, or that Trevithick deserved the sneer leveled at him by Stephenson's biographer, who had probably never tramped the world as an engineer and had no sympathy with a man who had lost his baggage.

Zerah Colburn says that to Trevithick is due the credit of high-pressure steam, he having broken the trammels of Watt's system of condensation. He also first used the internal firebox, employed exhaust steam in the chimney, used a horizontal cylinder and cranked axle, surrounded the cylinder with heat. He first drew a load by the adhesion of smooth wheels on an iron rail. In fact, he first made and ran a railway locomotive, and he proposed to Robert Stephenson the two horizontal cylinders and cranked axle with the cylinders in the smoke-box that were embodied in the "Planet," a locomotive in all respects of modern form, and one that was closely copied by both English and American engineers. It is curious to reflect that Trevithick probably ran his engine this very month of May, 1804, over the line that is now electrified, and that he built it on the site of the new power station and that his patent is dated March 24, 1802, he being then thirty-one years of age. He was born April 13, 1771, and died April 22, 1833. It may also be placed to his credit that he patented the screw propeller in 1815 and described several forms of it. This was long before it had been thought of by its reputed inventors. Trevithick was a man and an engineer and ought not to be forgotten. What would he have given to be present at our test last week with steam at 150 pounds and engines of 420 revolutions per minute that would almost stand complete in the cylinder of one of the old Cornish engines to which he was accustomed!

Since writing the foregoing I have called at the Museum and looked up the Trevithick relics. There are two drawings, one of them dated October 3, 1804, which show engines with flanged smooth wheels, and there are smooth wheels on a drawing copied from an original plan of 1803. On a printed ticket it is stated that the engine was made partly in Cornwall and partly at Pen-y-darren, and within a comparatively few years two men were living who had seen the engine run. It appears to have been made as the result of a wager made by one Homfray of the Pen-y-darren works with Crawshay of the Cyfarthfa works that he would transport iron from his works to the canal, a distance of nine miles, by the aid of steam power only. The Cyfarthfa works, which are close to Merthyr, are still at work, but now making steel. After the engine had been taken off the road it was employed for some purpose in the works, and one of the old men above mentioned had run it, and parts of the engine still formed portions of an engine at work, and one of the old men had all his life driven the old Trevithick engine.

In addition to the drawings, there is a photograph of a Trevithick engine dug up out of an old scrap heap at Hereford. It was made by a man named Haseldine, of Bridgenorth. The photograph stands on an old cast-iron boiler of Trevithick's, which resembles the boiler on the photograph. Alongside this is a wrought-iron boiler about 7 feet long with a through flue. One end is circular and contains the grate. The other end is reduced to a D-shape, to make room apparently at the flat side of the D for the end of the cylinder, which stands vertically inside the boiler, and drives a large flywheel above. The boiler shell is flared out to a flat top to hold the cylinder. The plates are small and single hand riveted, and the work is good. The engine is the first to have driven a threshing machine. The oldest existing locomotive is also in the Museum. It is the Hedley engine already named, and there is also exhibited a little geared frame made by Hedley to demonstrate that smooth wheels would serve. All this striving to prove that smooth wheels would adhere sufficiently to draw a load only shows that the Northumberland men either had to convince skeptics or were themselves behind Trevithick in clearness of vision, because Trevithick certainly laid it down firmly that smooth wheels would ordinarily suffice. The gradient at Merthyr-Tydfil is not one that one would choose to-day. It is very steep in the town through which the old tramway ran.

London.

Legal Notes.

ABSTRACTS OF SHOP LAW AS LAID DOWN IN RECENT CASES.

An employer must furnish reasonably safe appliances required in the work he engages workmen to perform, and keep them in good repair. (30 So. Rep. 889.)

It is the positive duty of the employer, which he cannot delegate so as to relieve himself from a failure to discharge it, to use reasonable care to place fit and competent persons in charge of his work. (111 Fed. Rep. 330.)

The duty of an employer to furnish his workmen with safe instrumentalities and appliances for the performance of their work applies to a foreman or superintendent as well as to a workman without rank or title. (88 N. W. Rep. 436.)

An employee after complaining of insufficient light continued to work on the promise of the foreman to furnish more light, which was not done, and it was held that the employer was liable for injuries resulting while performing the work ordered by the foreman. (65 S. W. Rep. 491.)

Where a workman remains at work after knowledge of the dangerous condition of the place where he is working, but the employer has promised to repair the defect, and the danger is not imminent, the workman does not assume the risk of remaining in such service. (50 Atl. Rep. 964.)

A promise on the part of the employer to repair a machine known by the employer and employee to be defective will not relieve the employee from exercising ordinary care in the operation of that machine, and he is required to exercise such care as is commensurate with the danger of operating the machine. (22 O. C. C. R. 518.)

Where one enters upon or continues in a service with full knowledge that it is dangerous, and of the extent of the danger, there is an implied contract of assumed risk, by which he waives his right to recover for injuries received in such service. (66 Pac. Rep. 799.)

Where an employee has knowledge of certain dangers incident to the employment the failure of the employer to give adequate warning of such dangers does not render the latter liable for an injury resulting from same. (65 S. W. Rep. 693.)

An employee assumes, not only the risk of accident occasioned by the negligence of his fellow servants, but also of the known negligence of his employer, if he

accepts or continues in such service after knowledge of such negligence. (40 S. E. Rep. 368.)

Where an employee is serving under a contract providing for his discharge should the employer "find" the employee "unfaithful or improper in the performance of his duties," the employer cannot arbitrarily discharge him. (72 N. Y. S. 1095.)

One who works during the dinner hour does not for that reason alone become a volunteer, so as to relieve the employer of liability for an injury to him resulting from a defect in the premises. (65 S. W. R. 835.)

The Federal Electric Blueprinting Machine.

The accompanying illustrations show a decided novelty in blueprinting machines, the novelty residing especially in the fact that the printing is continuous—the operator feeding the tracings into the machine like wet clothing into a clothes wringer.

The half-tone, Fig. 1, shows the general appearance of the machine and the section, Fig. 2, shows clearly its construction and operation. The wood drum *a* is revolved in the direction of the arrow by a belt from an overhead line shaft or, as with the machine shown in Fig. 1, by an electric motor, the speed of the drum being varied by the speed varying device shown at the top. A transparent traveling apron *b* is wound on a drum *c*, passes around the main drum *a* and serves the purpose of the glass in a common blueprint frame. The apron is under sharp tension and insures good contact. As the machine revolves, the apron winds up on drum *d* and when all on *d* is rewound again on *c* by hand. The length of apron supplied is 70 feet, which is the limit of length of print which it is possible to make. The roll of the print paper is placed in the trough at the front of the machine. The tracings are fed in behind it, or loose sheets of paper may be fed in with the tracings if preferred. In the rear of the machines are three arc lamps in a row with reflectors which concentrate the light on the passing tracings which, with the exposed prints, drop out in the box below. When working narrow prints one or two of the lights may be turned off or all may be concentrated on the narrow space and the work be thus expedited. The capacity of the machine is measured in yards and is said to be several yards a minute—the actual speed depending upon the use of the lamps and the sensitiveness of the paper. The machine is also arranged for sun printing and for printing by the sun in good weather and by lamps in bad. It is made in 30- and 42-inch widths, the latter machine occupying a floor space of 4 feet by 4 feet 2 inches, the hight being 4 feet 8 inches. The makers are the Spaulding Print Paper Company, of 44 Federal street, Boston, Mass.

Average Drawing Room Practice.

BY C. E. COOLIDGE.

The officers in charge of instruction in mechanical drawing in Sibley College, Cornell University, have felt the need of a drawing-room system that would be the average of the systems used in current practice.

In order to secure the data as a basis for establishing such a system, Professor Barr, of the machine-design department, promoted the scheme of sending a list of questions on drawing-room practice to several representative concerns in various lines of manufacturing.

The questions were limited in number,

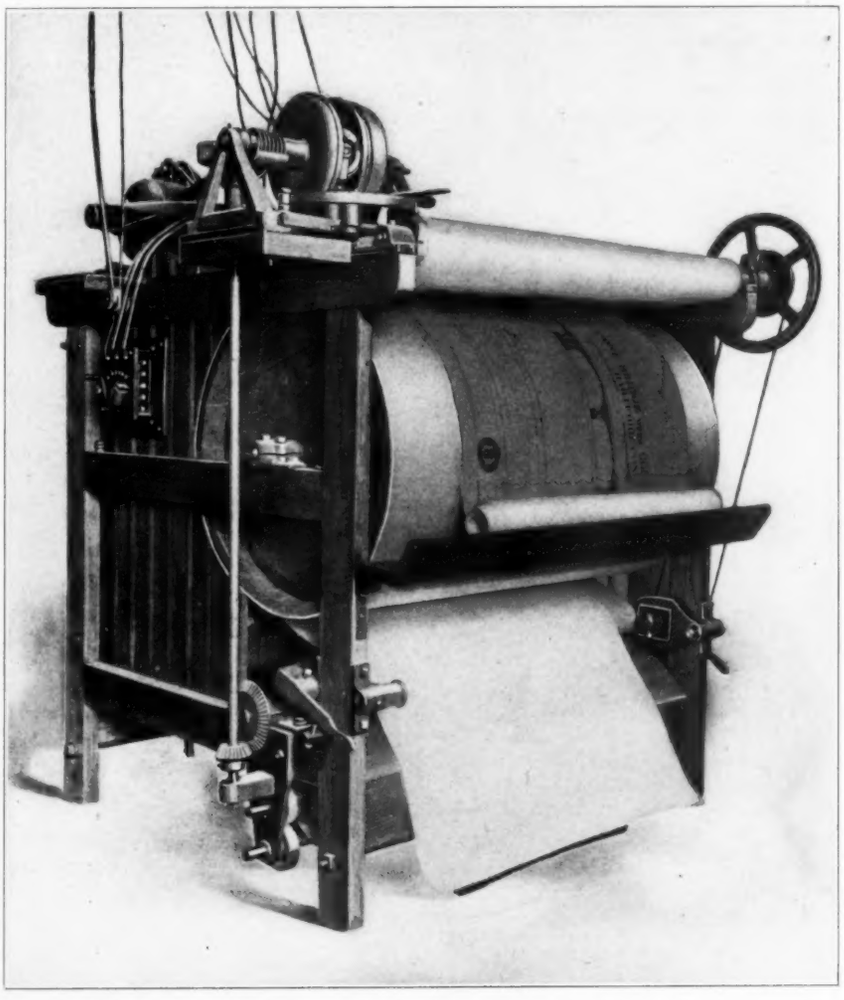


FIG. 1. A CONTINUOUS ELECTRIC BLUEPRINTING MACHINE.

but were intended to cover certain essentials. In addition to the questions, a request for blueprints was also sent, and we are very much pleased indeed with the hearty and generous response which followed those requests in nearly every case. The questions asked and the average of the answers are as follows:

1. What sizes of drawings and tracings do you make?

The sizes of drawings and tracings were found to vary greatly from the smallest size of 4½x6¾ to the largest size of 35x69. There were about sixty different sizes in between and the most popular sizes and their percentage of the whole used were 9x12, 6½ per cent.; 12x18, 11½ per cent.; 18x24, 13 per cent.; 24x36, 12 per cent. Bond paper was used to a considerable extent, and the extremely limited use of inked brown paper drawings was notable.

2. What scales do you employ for detail drawings?

The scales employed were ⅛, 3/16, ¼, ½, ⅝, ¾, 1, 1¼, 1½, 1⅓, 1 5/7, 2, 3, 4, 6 and 12 inches. The 3-inch scale was most often used. The ⅝, 1¼ and 1 5/7 inch scales were used in one or two cases.

3. What scales for general or assembly drawings?

The scales employed were the same as those for detail drawings. The 1½-inch scale was most often used and the ⅝, 1¼ and 8 inch scales were used in one or two cases.

4. Do you ever use 2 or 4 inches to the foot?

About 4 per cent. use 2 and 4 inch scales, but some of these qualify their statement by saying that they seldom use them.

5. Do you state the scale used on the drawing?

Eighty-five per cent. state the scale on the drawing. Some put a scale on a foun-

dation plan drawing only, while others put it on the lower edge of the tracing and cut it off the print.

6. What are your conventions for dimension lines?

The conventions for dimension lines were light lines whose characters were full lines, equal dashes, alternating long and one short dash, alternating long and two short dashes; 64 per cent. were full lines.

7. What are your conventions on center lines?

The conventions for center lines were the same variety as for dimension lines, with 42 per cent. for the alternating long and one short dash.

8. What are your conventions for extension lines?

The variety of conventions for extension lines were the same as for dimension lines, with 50 per cent. using short dashes.

9. How do you indicate alternate position of parts?

This question was not understood in every case, and I will state that it was intended to mean a position (an extreme or important one) of a moving piece that is shown on the drawing in addition to the one already shown; 88 per cent. used short dashes.

10. Do you use colored inks for such dimensions or center lines?

Twenty-nine per cent. used colored inks for their auxiliary lines and 71 per cent. used nothing but black ink.

11. Do you use different styles of cross-hatching for sections of different materials?

Fifty-five per cent. cross-hatch their sections with conventions for different materials and 45 per cent. do not. Some of those that conventionally hatch state that it is becoming a thing of the past with them.

12. If so, will you send us your conventions?

The conventions sent were the usual standards of the American Society of Mechanical Engineers, United States Navy, Cornell University, International School of Correspondence, Jones & Laughlin's, besides several individual standards.

13. If not, how do you indicate different materials?

Almost invariably the name of the material was printed on the section whether it was conventionally cross-hatched or not. Several concerns use soft crayon or lead on the back of the tracing to show a section and print the name of the material on it. Others use numbers or letters to represent the different grades of materials.

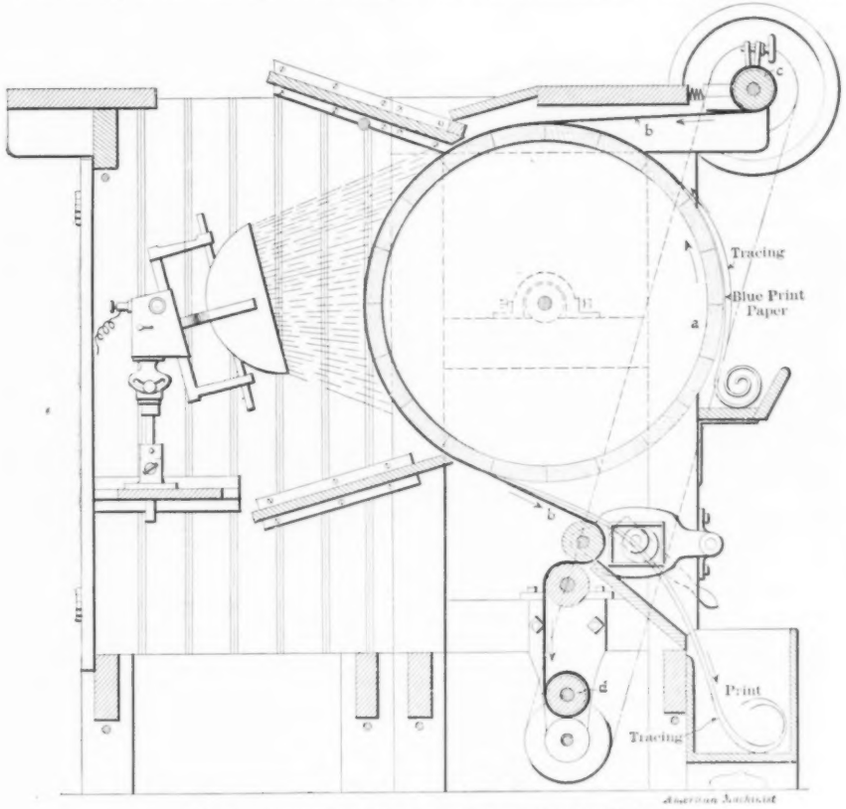


FIG. 2. CROSS-SECTION OF BLUEPRINTING MACHINE.

14. Do you ever use water colors for section?

Four per cent. state they do and 96 per cent. do not.

15. How do you indicate finish?

Finished surfaces are indicated by the letters *P, f, F, D, G, ff*, and other conventional characters marked on the line representing the finished surface. The letters *D, P, G* and *ff* stand for dressed, polished, ground and file finish, respectively. A great many prefer to print the full word as "bore," "turn," "spot face," etc. Red lines, parallel to the finished surfaces, on both tracing and prints, are made use of to a considerable extent.

Widening the line representing the finished surface and dimensioning to a line are other means shown; but the most unique scheme was a convention which apparently called for the amount of metal to be taken off in finishing a surface and was shown by the usual *f* with a fraction before it, as, for example, $\frac{1}{8}f$ meant that $\frac{1}{8}$ inch was to be taken off, and $\frac{1}{8}ff$ meant that $\frac{1}{4}$ inch or double $\frac{1}{8}f$ was to be taken off. This convention was ostensibly intended for the patternmaker. Seventy-one per cent. use an *f* mark for the finished surface.

16. Do you use shade lines for edges which cast shadows in either general or detail drawings?

Fifty-five per cent. use shade lines and 45 per cent. do not, and a great many that are using shade lines state that they intend to dispense with them.

17. Do you use surface line shading?

Twenty per cent. use surface line shading and 80 per cent. do not, and a great many state that they use it mostly for display and then only sparingly.

18. Up to what sizes do you give dimensions in inches, or beyond what sizes do you give them in feet and inches?

Dimensions were given in inches up to 24, 36, 48, 60, 72, 96, 100 and 120. Fifty per cent. of the concerns limit the dimensions in inches at 24 inches.

19. Do you use first or third angle projection?

This question was misunderstood in a few cases. I will state that the popular conception defines the first angle as that used when the top view of the object is below and the elevation above, and the third angle when the top view is above and the elevation below. There are others who define third angle projection, not by the mere rule of relative position of a projection, but by the rule that the near side of each view of an object is projected on the plane of the paper. The latter conception of projecting the near side covers any case whatsoever, whether there is a natural top to an object or not. Incidentally, I would state that one of the leading engine firms in America calls third angle projection the "American system," presumably in contradistinction to the practice in England, which is mostly first angle projection. The Baldwin Locomotive Works, of Philadelphia, state that, as far as they know, they were the first to introduce third angle projection in practice. Mr. W. L. Austin, of the company, introduced it in the works thirty years ago and afterwards in 1878 introduced it into the Spring Garden Institute, of Philadelphia, where it has been taught ever since. Eighty-five per cent. use third angle projection and 15 per cent. use first angle projection.

From the blueprints and other correspondence we note a few other points of common interest:

A bill of material is commonly put on the drawing; the title is almost invariably placed in the lower right-hand corner; dimensions read from the bottom and right-hand side of drawing with a rare exception of figures reading one way; the entire absence of inclined division lines in fractions; the use of plain lettering made up of the three types, viz., vertical capitals, inclined capitals, and script; the free use of plain English notes in place of unnecessary views, and firm and bold lines without embellishments of any sort.

Some firms have independent printed sheets on which are listed and described each piece that goes into a particular machine built on order, and almost all concerns have a commendably efficient and elaborate shop order system which moves the work in proper rotation from the main office through the different departments to the place of delivery, and it is a notable fact that nothing seems to be overlooked, even to the order for the transfer of complete and incomplete machined parts from one part of the shop to the other.

Summing up and reviewing the data we have acquired, it is strikingly convincing that the most simple, lucid and comprehensive drafting-room system in general that can be devised is the one with the fewest of the meaningless conventions that are so often a part of a drafting-room system. A drawing not only serves the supervising engineer or the draftsman who makes the conventions, but also the mechanic who is to carve and mold a sensible form from a too often senseless drawing. A free use of good Anglo-Saxon is better understood than a pretty cobweb of fanciful lines.

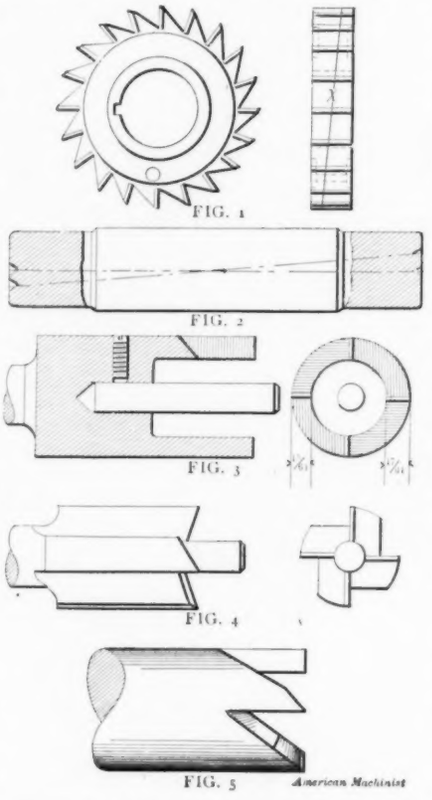
Special Operations in Making Mills and Counterbores.

BY E. R. MARKHAM.

We had 500,000 pieces of a kind to make in a shop which I was connected with. Each of these pieces had a slot milled across the face. The slot was 1½ inches long, ½ inch wide and ¼ inch deep. When taking the finish cut we used a cutter made in two parts. The teeth were *dodged*—that is, every other tooth on the face of the mills going together was cut away, so that the tooth remaining on the face of the opposite half of the mill dodged into the recess made by the cutting away of the tooth. This is a very common form of mill for the purpose mentioned, as it can be shimmed apart after grinding, to make the slot any desired width within its range, yet not leaving any fin, as would be the case were two ordinary flat cutters put together.

The mill worked very nicely, but was costly. One of the men suggested making an arbor having two sets of centers, one set the regular centers and the other offset 3-16 of an inch, on opposite sides of the center of the arbor.

Our cutter blank was to be placed on this arbor or mandrel as nearly central as possible, one side to be faced on the regular centers and the opposite side to be faced on the eccentric centers. When both pieces that were to make up our cutter had been machined in this fashion the angling surfaces were placed together, the thick edge of one to the thin edge of the other, and a 3-16 inch hole was drilled through both for a pin. The cutter thus put together was then splined and the teeth were cut. After hardening it was ground and it was then ready for use. The cost of making was much less than for a cutter with dodged or interlocking teeth, and it gave as good satisfaction. It could of course be shimmed apart and still have the teeth, or some of them, long enough to leave no fin on the work. Fig. 1 shows two views of the cutter, the dividing line



SPECIAL OPERATIONS IN MAKING MILLS AND COUNTERBORES.

being at *x*. Fig. 2 shows the mandrel with the eccentric centers used in facing and turning the cutter.

It is sometimes desirable to use a hollow mill having a pilot, as in Fig. 3, in place of a counterbore when enlarging a hole that is to go entirely through a piece, and especially is this true when the stock being cut is not very thick. If a counterbore is used in cutting through thin stock it is liable to run when the remaining stock becomes too thin to support the pilot unless the face of the counterbore is made as shown in Fig. 4, and even if made of this shape it is difficult to grind. The commonly expressed objection to using a hollow mill for this class of work is that the piece of stock removed has a tendency to stick in the mill. This can be overcome, however, by making the clearance hole in the mill eccentric to the outside. As this does not require exactness, the eccentricity may be given by putting the mill—after the hole for the pilot has been finished and the outside turned to size—in an independent jawed chuck, throwing the jaws over so that the outside of the mill runs from 1-100 to 1-64 inch out of true, and while thus chucked boring the clearance hole to the required size and depth. The teeth should now be cut. It is advisable to cut them of a form that allows them considerable depth and yet leaves them strong. This form of tooth is shown in Fig. 5. The teeth may be backed off for cut, and the mill is then ready for hardening.

Care should be taken when heating not to heat very much above the teeth. When the proper heat has been attained the mill should be inverted and hardened in the bath with the teeth *up* and it should be worked up and down rapidly in the bath in order to force the contents of the bath into the hole.

Better results always are attained if this method of dipping is adopted with pieces having holes running *part* way through them, as then the steam can escape and the water can enter the hole; whereas if dipped with the opening down, steam which generates rises in the hole and as there becomes more steam than the hole can contain it escapes from the bottom and blows the water from the teeth, not allowing them to harden properly. Vapors generated in the bath are a source of annoyance often overlooked by inexperienced hardeners, and probably cause as much trouble as any one thing.

Centering Machine.

The illustrations show a machine, built by the Binghamton Machine Tool Works, of Binghamton, N. Y., for centering stock from ¼ to 3 inches in diameter.

The half-tone, Fig. 1, gives a good idea of the machine as a whole, the construction of the head being shown in Fig. 2. The chuck for holding the stock is secured to the front end of the head. The spindle, carrying a drawback collet for holding a combination center drill, runs in a sleeve fitted in the head, and is driven by a three-step cone at the rear. It will be noticed that this cone instead of being mounted directly on the spindle, runs on a sleeve driven in the back end of the head. The spindle extends back through this sleeve and is connected to the cone in the manner shown. With this arrangement a rigid construction is possible—the pull of the belt in no way affecting the spindle.

The drill is fed into the work by means of the lever at the side of the head; this lever turns a pinion meshing with a rack cut in the sleeve in which the spindle runs. A stop is provided so that work may be centered to an exact depth. An adjustable

rest on the long bar under the chuck supports the work being centered, and for very long stock the floor stand with an adjustable rest at the top is used.

The machine is supplied with oil reservoir, drill sockets, combination center drills, etc. The countershaft has tight and loose pulleys 7 inches in diameter, for 2-inch belt, and should run at 500 turns per minute.

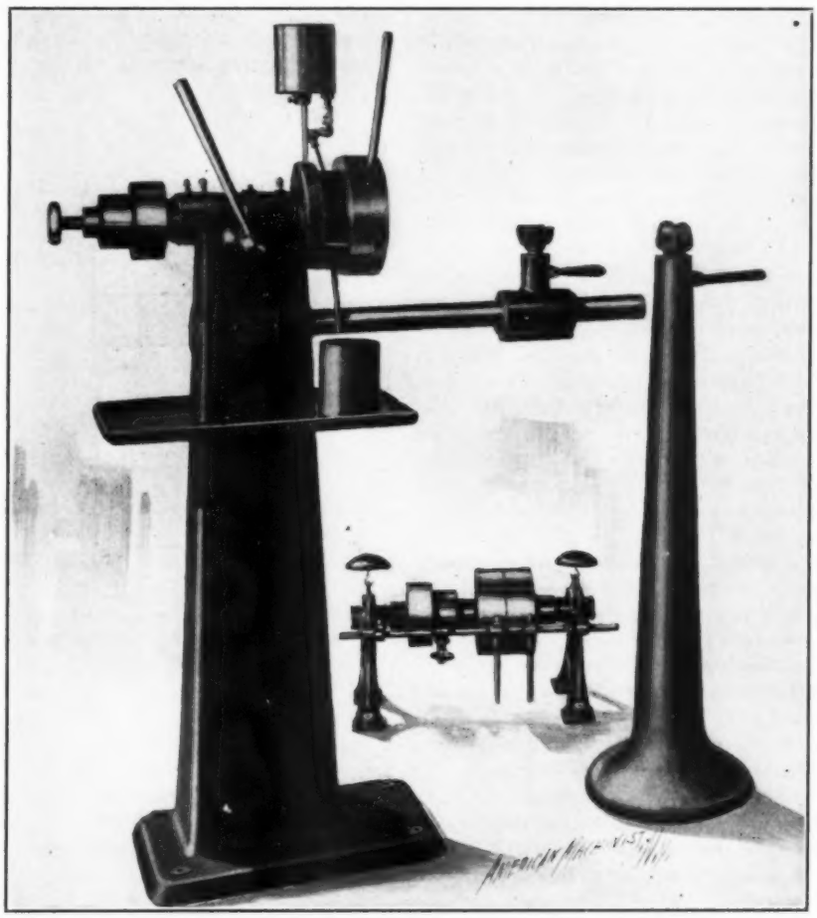


FIG. 1. CENTERING MACHINE.

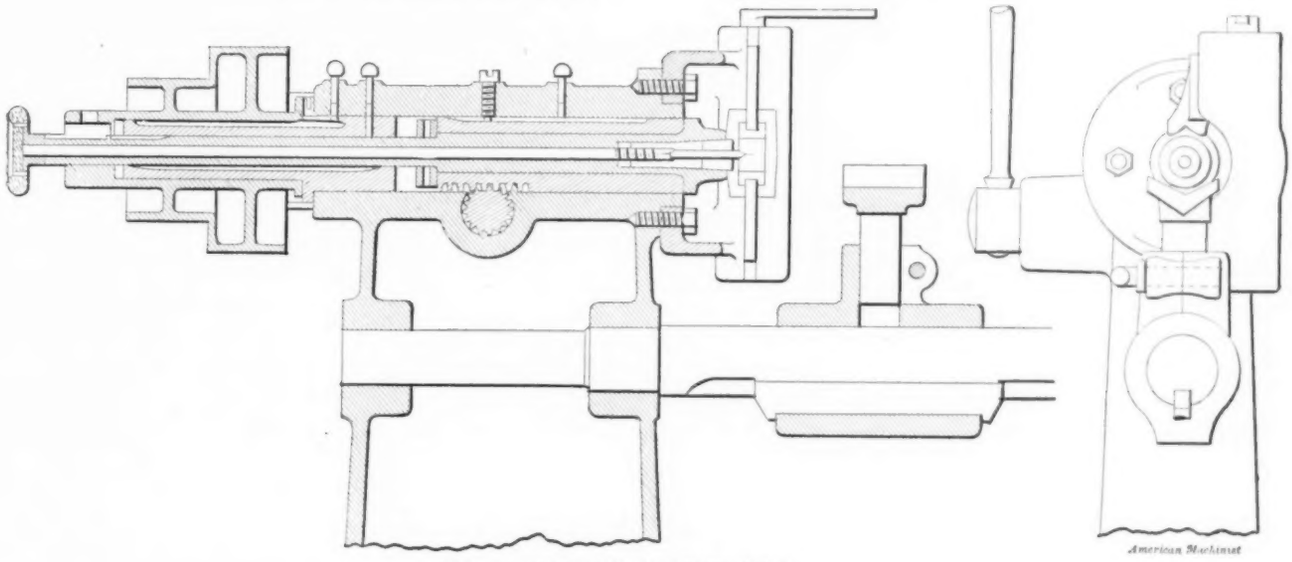


FIG. 2. CENTERING MACHINE HEAD.

A Hard Alloy of Copper.

A United States patent has recently issued to S. L. Walter and F. W. Keiner, of Ekastown, Pa., for a process of hardening copper. It is in fact rather a process for producing an alloy of aluminum and copper, and is interesting in its suggestion of the precautions to be observed in melting aluminum. The process is described as follows:

In carrying out the proces there is taken of the following ingredients by weight: Copper, 32 parts; aluminum, 5 parts; powdered charcoal, 1 part. The aluminum and charcoal are first placed in a suitable crucible or furnace, and the copper is then added as a superposed mass. Heat is then applied to the crucible to fuse the metals, causing ignition of the charcoal, the carbonic-acid gas from which passes upward through the copper, carrying off any moisture contained in the metals and forming above the crucible a cushion of highly-heated gas that will operate effectively to preclude entrance of atmospheric air to the crucible, thereby obviating any possibility of oxidation of the metal, whereby an intimate combination thereof will ensue. By reason of the fact that the copper is placed on top of the aluminum it will by its greater specific gravity and upon fusion sink down upon and become thoroughly combined or incorporated with the aluminum without requiring any mechanical agitation or stirring to produce the required combination. The resulting alloy possesses qualities of toughness and closeness of fiber that will render it valuable in arts requiring a metal possessing these qualities and the added quality of being non-oxidizable in character.

We learn from a newspaper item that Prof. Willis L. Moore, chief of the Weather Bureau, has filed application for a patent on what he calls a gravity, cooling, drying and purifying machine, which he is said to claim will enable rooms to be kept at a temperature of about 70 degrees in the hottest weather. No description of the machine has so far been given, we think.

We would like to receive the names and addresses of all those who have continuously subscribed for or read the AMERICAN MACHINIST since its beginning in 1877.

Letters From Practical Men.

Shellacking Blueprints.

Editor American Machinist:

I have found what I consider the best way to shellac a blueprint. I use an atomizer, which is nothing more than two tubes of tin joined together with a wire link as in the illustration. One can be procured at almost any art store for 10

ATOMIZER FOR SHELLACKING BLUEPRINTS.

cents. I fill a bottle half full of wood alcohol, then put in just enough white shellac to make the mixture opaque. After setting the blueprint in a vertical position, insert the short tube of the atomizer into the fluid and blow into the long one. A very fine spray will be the result, the density of which can be gaged by changing the angle of the tubes. By fixing a blueprint on both sides it can be made almost as durable as cloth. MAC.

An Inexpensive Drawing Table.

Editor American Machinist:

For some time past I have been following the drawings and descriptions of the inexpensive drawing tables as they have appeared in your columns, as I wanted one for my own private use. The board and table shown and described at page 446 by A. P. is handy, neat and commendable in several ways. I thought it would fill the bill for me very nicely and soon began building one—on paper, but gave it up when I found it would not shut up tight. No doubt it exactly meets the needs of its designer, but I need something that will fold up compactly so as to be placed in a clothes closet or other convenient place out of sight when not in use. Consequently, I started out along my own lines to secure that something, and, so far as my personal needs are concerned, I have succeeded to my own satisfaction. I enclose herewith a drawing of the table, trusting it may be of interest to your readers. It carries a board 36x60 inches, made of 1x12-inch white pine. If so desired, the table can be made with an ordinary top on which to use a small drawing board. The table is made throughout of white pine and is sufficiently rigid for all practical purposes, yet yields readily to atmospheric changes.

To avoid confusion, the cross braces *F* and *G* have been omitted from the drawing of the front elevation, but their location is made plain in the end view. In all other respects the drawing explains the construction. To shut up the table for storing away, raise the top and remove the round *C*, swing the top of legs *B* back around *H* as a center till they come nearly into the plane occupied by legs *A*, then lower the top till the 3-inch side pieces enclose both pairs of legs. If desired, the board can be suspended in a vertical position supported by the round at the top of legs *A*.

The table shown will admit of three adjustments for angle of inclination. In the lowest position the front and back edges are respectively 32 and 32½ inches high; in the intermediate position, 32½ and 37 inches, and in the highest position, 31½ and 40 inches. The hight and the angles of inclination are most comfortable and satisfactory for the average man when he uses a 25½-inch stool. Cross-pieces *D* and *E* afford convenient foot rests.

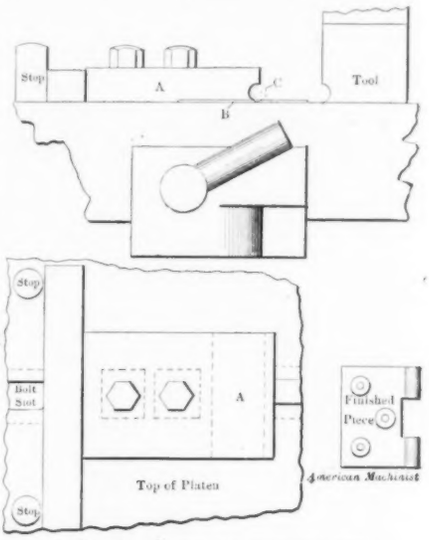
If a table is desired with a level top adjustable for either a sitting or standing position, the only change necessary is to make the legs longer, make them equal in length and pivot them in the middle.

J. O. NEIKIRK.

A Press Job on the Planer.

Editor American Machinist:

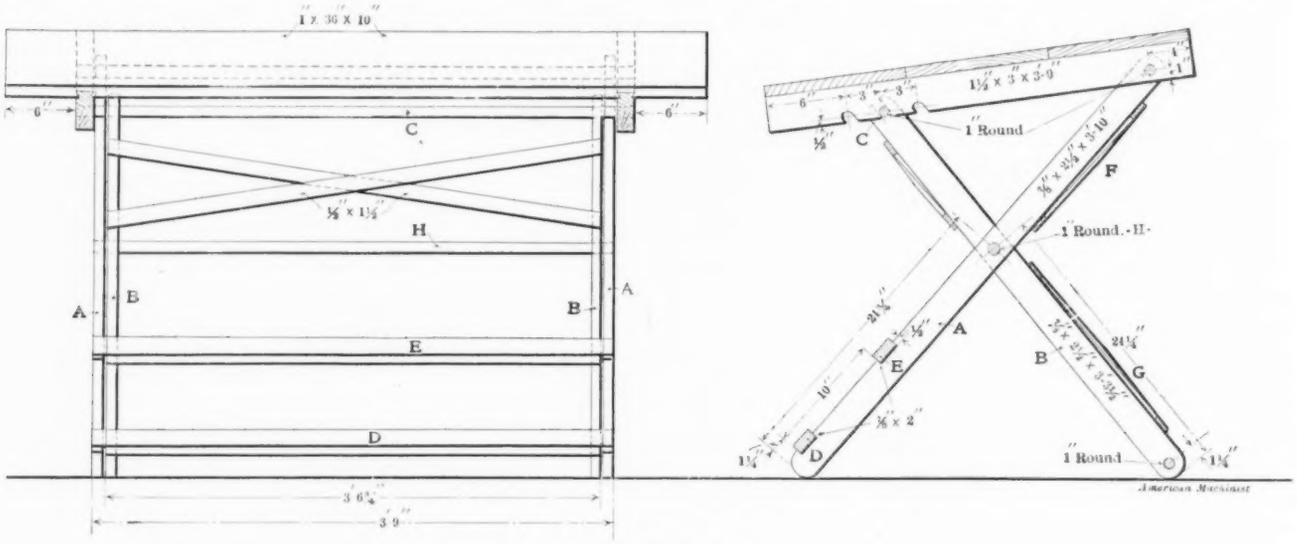
The sketch shows how a "wiring" job can be done on any planer as well as in a press with an expensive set of dies. *A*



A "WIRING" JOB ON THE PLANER.

is a hold-down or gage bolted on the platen and backed with positive stops. *B* is the blank in position, and the dotted lines at *C* show it after the tool has bumped it. The operator has merely to push the blanks into position. A shaper could be used, with the advantage of a more positive stroke.

Toledo, Ohio. CARROLL ASHLEY.



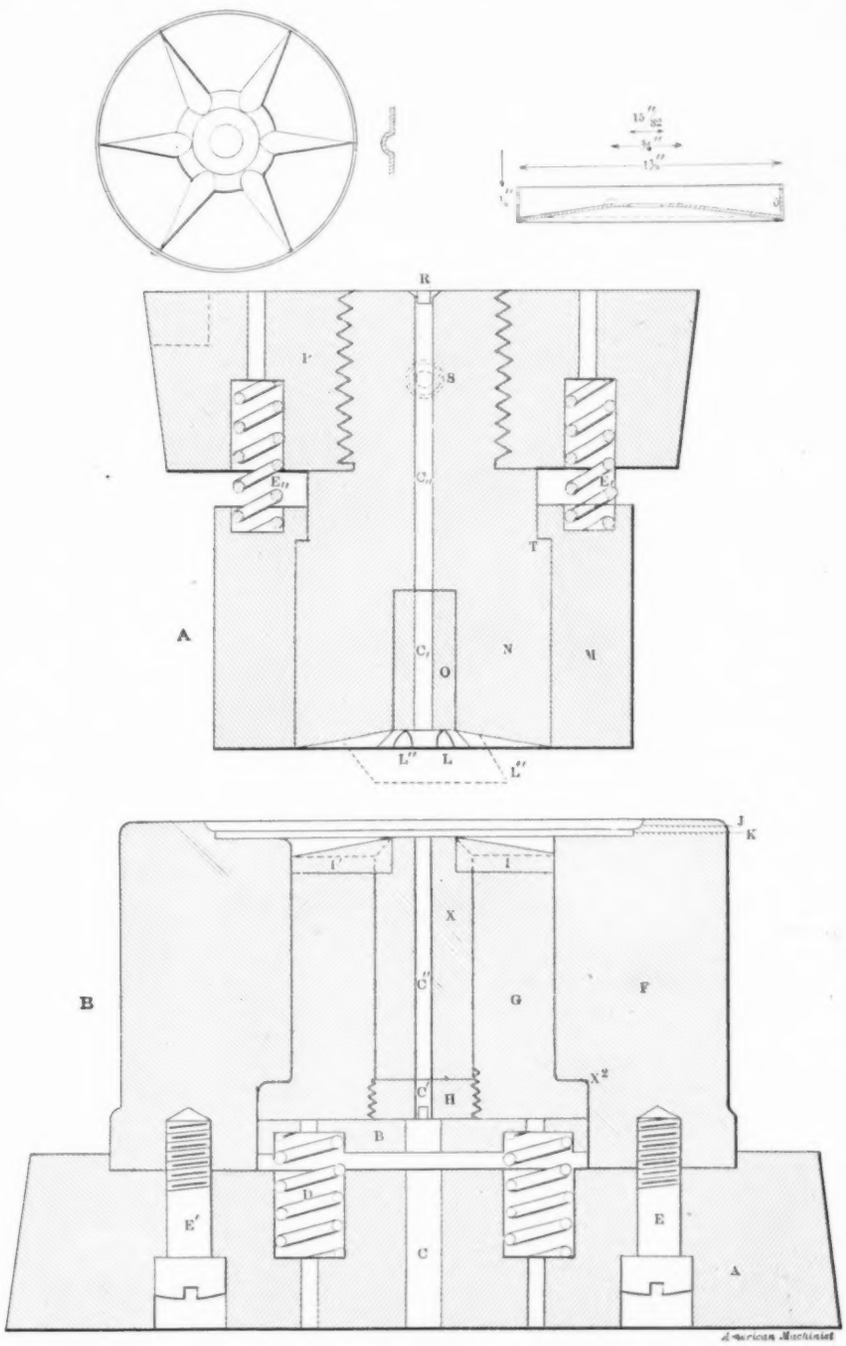
ANOTHER DRAWING TABLE.

Combined Drawing and Forming Die.

Editor American Machinist:

The punch and die *A* and *B* are for producing the piece shown above them. This is an aluminum cup, used as a guard ring on the armature of the recording wattmeter built by the General Electric

Company. This cup is of sheet aluminum, .012 inch thick, ¼ inch deep and 1⅞ inches in diameter. It has a six-pointed star raised on the bottom to give it rigidity. There is a 5-16 inch hole punched in the center and four No. 60 holes, besides two 3-16 inch scallops in the shell part, the making of which is all performed in one operation by a punch and die arranged with cams (not described in this article).



A COMBINED DRAWING AND FORMING DIE.

The operation of the die is as follows: *F* and *N* are the punch and die necessary to draw the shell. *G* is the formed knockout for forming the star upon the bottom of the punching. *I*, *I* are longitudinal sections of the star-points which are dovetailed into the face of the knockout. They are not only dovetailed into the knockout *G*, but they are also tapered longitudinally so that after they are driven into place (which is done from the center) there is no chance of their working loose. The piece *X* is then driven in. It is cut out on the sides, to allow the pieces *I I* to exactly fit into it, and it is in turn held in place by the screw *H*.

This was the only way that I found practicable, as it permits an accurate forming of the star points in the knockout, which is a very difficult matter. The form or radii of the points are constantly changing as they approach the tips. Again, the points meet the beveled center piece in such a manner as to make perfect construction both slow and tedious. I also believe it is much easier to repair when constructed in this manner.

C C′ C″ is an air vent, and a similar one may be noticed in the punch. It will be noted that under the knockout *G* is a machine-steel plate *B*, which is counterbored to guide the springs *D*, six in number. I put this plate in to avoid any damage which might happen to the hardened knockout *G* should the springs cramp and break. *K* is cut out to receive the blank, and *J* is cupped to facilitate the centering of the blank. By noting the center piece of the knockout, it will be seen that a movement of ⅛ inch will give the necessary depth to the cup, and the plate *B* and the knockout having a play of ⅛ inch from *X²*. When the plate bottoms upon the holder *A* the pressure flattens out the bottom of the punching. The outer ring *F* of the die is held in place by four screws *E*. It is also fitted into the holder *A*.

The punch *N* is cut out to receive the form of knockout *G*, allowing for the thickness of the stock. *L L* are planed out in the punch to correspond to *I I* in the die. This was done by removing the stock at *O*, and after planing the flutes of the punch the hole was plugged up. *M* is a stripper for the punch *N*. It is held in place by the shoulder *T*, and its pressure is delivered by twelve springs *E*. The distance between the bottom of the stripper and the punch plate is accurately measured to bring the shoulder on the punching at the right hight. This shoulder is afterwards trimmed off.

The die was first designed to use a blank of such a size as to give the right hight without trimming, but as only .003 inch was allowed in hight and a perfect edge was required it was decided to trim it. The punch is screwed into the punch plate *P* and held by the set-screw *S*.

As the punch descends into the die with the blank interposed, the stripper *M* grips the blank, preventing the stock from wrinkling. The stripper is turned to fit the cupped gage for the blank, thus acting as a guide for the punch *N*. This avoids any shearing tendency on the part of the punch.

The most difficult problem was to obtain sharp detail on the punching, it being aluminum. Although with brass I could get absolute sharpness, I had to favor the aluminum slightly by giving the drawing edge of the punch a little more of a round. It would draw over the edge of the die all right, but would break out at the bottom before the punch had been let into the die to the full depth. J. W. WHITE.

The Speed of Friction Gears.

Editor American Machinist:

I found great interest in the article (page 754) on "Paper and Iron Friction Gearing," by Edward C. De Wolfe, but I did not find any mention of what surface speed he has found most advantageous.

Referring to page 274, Vol. 24, one of your correspondents recommends a speed of 1,200 feet a minute. As I have seen frictions running over 3,000 feet a minute, but not having an opportunity to examine their work, I think it would enlighten many of your readers if Mr. De Wolfe would give what, in his estimation or experience, he found the best speed for these frictions. GEORGE HARRINGTON.

Brantford, Ont.

[The limiting speed of 1,200 feet per minute referred to is recommended for paper or mill board friction disks when the driver runs continuously and the load is alternately thrown on and off. We can see no reason for fixing a limit of speed for friction disks running together continuously, below that at which the strength of the material is just sufficient to resist the centrifugal force.—Ed.]

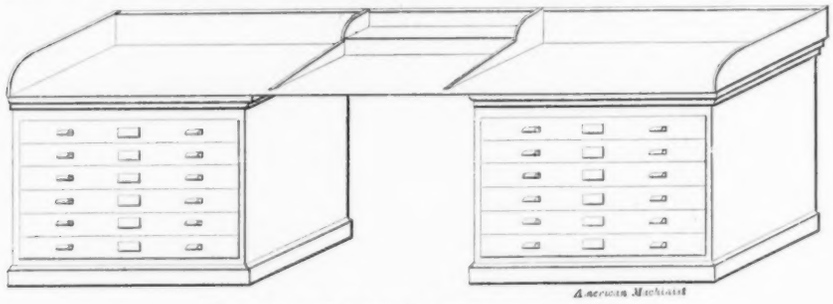
Notes for the Drawing Room.

Editor American Machinist:

"Bore 19 inches full, turn 19 inches scant." Such directions as these are still to be found occasionally upon drawings for cylinders and their plungers, and also upon other drawings where the meaning of the terms is not so obvious. This method of giving dimensions leaves much to the judgment of the workman, and, although he may be trusted to produce practical results when he controls both the parts to be fitted together, he often has to do with a single piece and make the best guess he can regarding the amount of allowance required. The expression "19 inches full" has no well-defined meaning short of 20 inches, and the same is true of 19 inches scant, which may mean anything between 18 and 19 inches. If such a dimension is given as 19 31-64 full the natural inference is that the allowance must be less than 1-64 inch; but with the even inches there is no such limit, and the machinist must inform himself the best way he can regarding the requirements of the case. A much better record of the work done is preserved if the limit is defined upon the drawing, and the dimension 19 + 1-16 or 19 + 1-64 is at once understood and worked to without requiring any further thought, and when a rush order comes for a new casting to repair a breakdown the drawing shows at once whether the allowance was made by boring the cylinder large or turning the plunger small or by doing both. To divide the allowance, where no defining limit has been given, increases the probability that when a spare is ordered for either part it will go into place without further scraping or fitting. It is, however, very common practice to turn a plunger or a large screw as exactly to the given dimension as the character of the work calls for, and make the allowance required in the cylinder or the nut. If a repair is ordered, and no gage is furnished for working to, it is fair to presume that it is to be finished on this principle.

Large castings of very irregular shape requiring machine work on many different planes are sometimes provided with a narrow strip along which a planer cut can be taken to serve as a base from which measurements may be made. Where figures can thus be given to a common base line, the laying out of the work in the shop is often greatly facilitated, and this trifling forethought in the drawing room results in a saving of dollars in machinists' wages and, what is at times of still greater importance, assists in getting the work out on time.

In checking drawings, where figures are found to be in error, it is a good plan to merely indicate that the dimensions noted are not right and return the sheet to the draftsman to determine the correct ones. If the person checking the drawings corrects large numbers of figures himself, he is liable to make mistakes and there is no one to check his work. It also tends to render men more careful to know that their faulty work is sure to come back to them for correction.



DRAWING TABLE FOR USE WITH FLAT BOARDS.

The large curves, made up of a succession of straight lines which are so often seen on drawings may be produced most smoothly if the pencil is never lifted from the paper during their execution. That is, after the ordinates have been laid down or the points on the curve otherwise determined, draw a straight line from the first to the second and then, without raising the pencil from the paper slide the triangle or other straight edge along in contact with the pencil into position for drawing the next portion of the curve. The result will be a much smoother curve than if the pencil is lifted at each step of the operation.

Draftsmen often require to use pencils of several degrees of hardness upon the same drawing, and it would be well if the manufacturers would use some more distinctive marking to indicate the various grades, as much inconvenience is felt in so often taking up the the wrong pencil. If in addition to stamping the grade in figures or letters a different color of finish were used this trouble would be entirely obviated. Some men do this for themselves by scraping the varnish from the upper part of the pencil and staining the wood so exposed with colored ink.

Of all the varieties of drawing boards probably the one in most general use at the present time is the plain flat board used on a level table with blocks, or perhaps bricks, under the board to give it the inclination desired. These makeshift supports should be replaced by triangular pieces of wood placed flush with the edge of the drawing board, so that pencils, tools, sketches, etc., cannot work their way in under it. They are best when fastened permanently to the table; not to the boards, as is sometimes done, in which case a pair of them is required for every board, and they are then less readily handled and stored when not in use. A shelf at the top of the board is a great convenience, and will pay for itself a dozen times in the course of a year. It is to be presumed that the table will be about three times as long as the drawing board, giving room for a tool tray on one side and reference drawings on the other. The space under the table on either side of the draftsman gives room for drawers in which drawings may be kept. If the table is not placed with its back against a wall, it should be provided with a raised guard along the back and ends, to prevent articles being pushed off on to the floor. Such a table is shown in the illustration. Much time is often lost in looking for things which have fallen or been mislaid and the matter is of more importance than is generally supposed. The problem of the convenient disposition of tools and references is what chiefly retards the more extended use of the upright drawing boards, which in other respects have much to recommend them. The working side of all drawing tables, and the lower edges of the boards should be rounded off, so that drawings which chance to overhang will not be creased or broken should a person accidentally lean against them. GERALD E. FLANAGAN.

Straightening by Shrinkage.

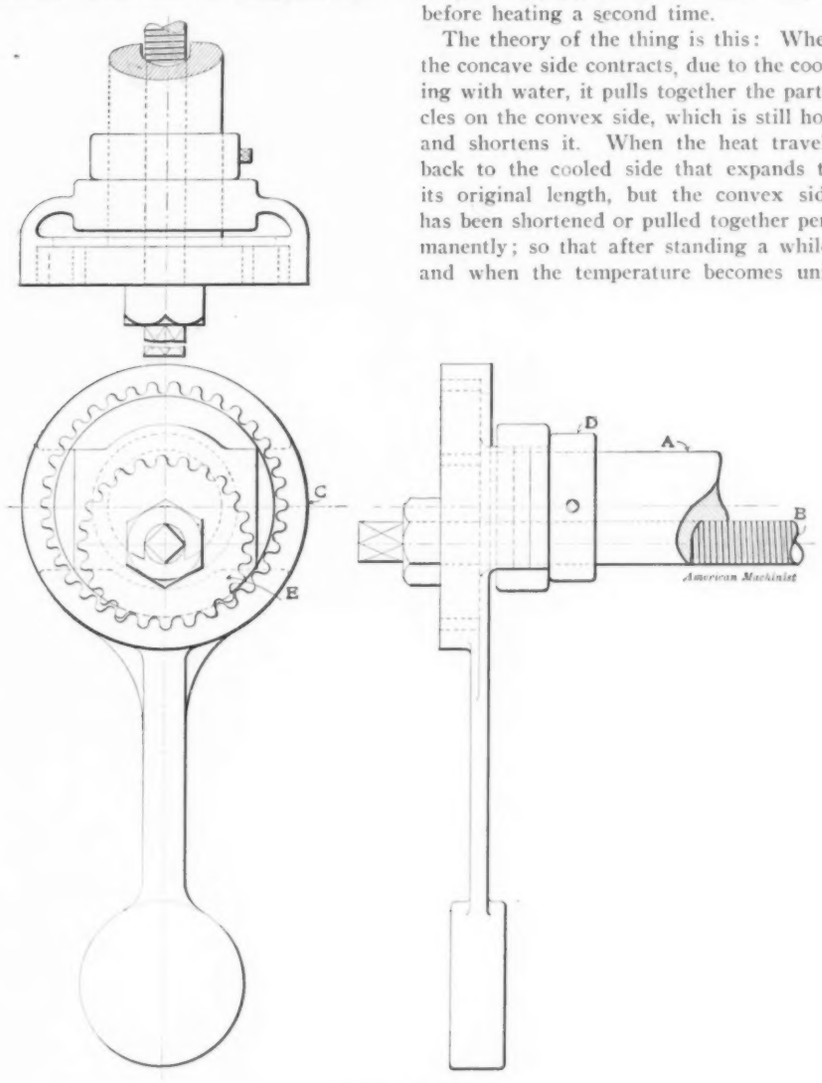
Editor American Machinist:

I have read with great interest the recent articles on peening, especially the one by Mr. Hutchinson, at page 702, who straightened a 13-inch shaft by peening. This brought to my memory a job which I helped to do as an apprentice some twelve years ago. This was a 4-inch piston rod of a steam hammer which was bent ¾ inch in its length, probably due to the hammers continually pounding on an uneven bottom block, or the nasty habit

the smith had of using the front side of the hammer.

To my mind this bent rod seemed an awful calamity, as I knew it could not be pounded back again with a 14-pound sledge, much less with a 1-pound hammer, as some of our contemporaries seem to think advisable.

The old fellow I worked with—"Dick," we called him—smiled when I put the question, "How shall we straighten that?"



BORING BAR FEED.

"Well," said he, "we're not stuck; we can get that as straight as ever it was, and the wrinkle will be worth many a dollar to you." To cut matters short, we yanked it down to the angle smith, who had the reputation of being an expert on this straightening business. The piston was put over a gentle fire and heated to a uniform dull red for a convenient length where it was seemingly bent the worst. It was then taken off the fire and put on a slab, and the straight-edge applied; a dipper of water was then poured on the *concave* side—in fact several dippers, according to the judgment of the operator. This partially cooled the concave side, and it was then allowed to cool by itself for about 15 minutes, until the heat from the hot side had traveled to the cool side, the piece becoming of a nearly uniform temperature. The straight-edge was applied again and the rod was found to be much better. This operation was repeated some three or four times by the smith, and in about two hours we had a piston that was surprisingly true. I would advise beginners with this method to go slow and to learn the results of the first heating before heating a second time.

The theory of the thing is this: When the concave side contracts, due to the cooling with water, it pulls together the particles on the convex side, which is still hot, and shortens it. When the heat travels back to the cooled side that expands to its original length, but the convex side has been shortened or pulled together permanently; so that after standing a while, and when the temperature becomes uniform the piece will be found to be straightened.

Wrought iron or mild steel under repeated sudden shocks assumes a crystalline structure, which is not very desirable in a steam hammer piston. No doubt in this case of the bent piston the original structure was not very uniform, and the heating if anything improved it rather than set up any new and undue strains. This assertion may be questioned, but there can be no doubt that this method of straightening is far better than any method of peening, and I figure that Mr. Hutchinson could have saved a day's labor, anyway, for the gang that did the slugging.

A. PIDGEN.

Another Self-Acting Feed for Boring Bars.

Editor American Machinist:

Mr. Patterson's article at page 376, describing a "pendulum" boring bar feed, reminds me of one almost similar, though made for a different kind of bar.

Since you have begun to interest your readers by publishing occasionally an article on "Mechanical Antiquities" the following may interest some of them:

In the winter of 1895 and 1896 I was supervising some government work. The contractor came to me one day and asked me if I could not devise some good way of replacing their star-wheel feed, as he was not at all satisfied with it. The accompanying blueprint and a little explanation will show how the unsatisfactory wheel was replaced by a better (?) feeding device. (That is what the contractor thought.)

A is the boring bar, which was a hollow cast-iron cylinder some 10 or 12 inches in diameter; *B* is the feed screw; *C* is the "pendulum" crown gear; *D* is a collar which kept the "pendulum" in position with pinion *E*, which drives feed screw. Whenever it was necessary to run the boring head back, the collar was loosened and collar and pendulum were moved away from the pinion *E*, then the head could be returned by a crank set on the square end of the feed screw.

The various elements of the gearing are easily determined from the following, where:

f = feed per turn of boring bar,
v = threads per inch in feed screw,
N = teeth in pendulum gear,
n = teeth in pinion.

$$\frac{n}{N} = 1 - fv \qquad (1)$$

$$n = N(1 - fv) \qquad (2)$$

$$N = \frac{n}{1 - fv} \qquad (3)$$

$$v = \frac{1}{f}\left(1 - \frac{n}{N}\right) \qquad (4)$$

$$f = \frac{1}{v}\left(1 - \frac{N}{n}\right) \qquad (5)$$

J. A. G. GOULET.

Westmount, Canada.

Foreign Addresses.

Editor American Machinist:

Referring (page 772) to Mr. Bollinckx's (Brussels, Belgium) remarks regarding poor addressing of catalogs to foreign inquirers, we beg to state that we have received numerous inquiries from foreign countries in reply to our advertisements in the AMERICAN MACHINIST, and not more than one-quarter of them give the name of the country they are from, and the hunting up of locations of towns from that cause is quite an annoyance.

ESTEP & DOLAN.

[Most foreign correspondents are very remiss in this matter, seeming to take it for granted that nothing more than the name of the town in which they live is

necessary. Canadians, for instance, too often follow the English custom in this regard. The other day we had a letter dated "Galt," that is all. We guessed from the contents of the letter that Galt, Ontario, Canada, was meant, though there are no less than eight Galts in as many States of the United States. Nothing is better settled as a result of experience than that the *full address* of the writer should be upon *every* letter.—Ed.]

Rig for Drilling a Special Nut.

Editor American Machinist:

The first time I saw the operation described herewith it interested me not a little, and I also thought it might interest readers of the AMERICAN MACHINIST. In Fig. 3 will be seen a spring made out of ⅛ wire, one turn being fixed at either end to a three-pronged nut. The operation was the drilling of this nut to suit the spring. As will be noticed, the hole has to be circular about the center, also at a spiral. An 8-inch swing lathe being out of use, it was altered for the job. An Almond chuck was put on the spindle to grip the small drill. The tool-post slide was taken off and a new slide *A* with a vertical pillar *B* put on in its place. Casting *C* was made to swivel about *B*, made equal to the pitch of the spring. *G* was a piece of round stock gashed to fit on the screw to act as a nut, *H* being a stop on the bed so that the saddle could always be brought back to the same position. The *modus operandi* for drilling is as follows: Swivel *C* until the angle of the spindle is equal to the pitch angle of the spring and bring the saddle up against the stop *H*, as in Figs. 1 and 2. Turn the knob *F* until the first prong is

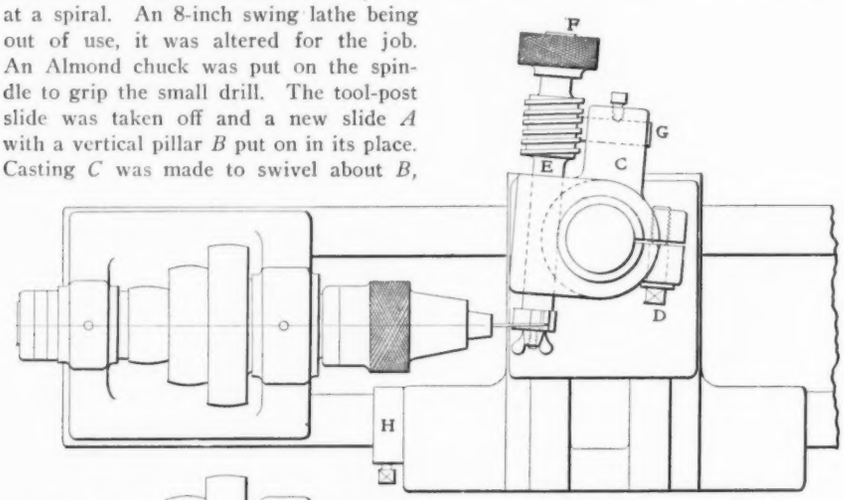


FIG. 1.

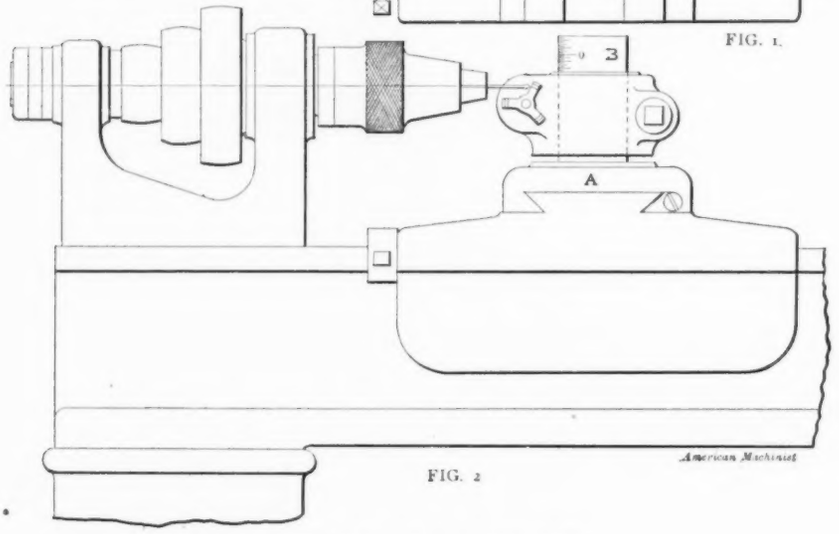


FIG. 2

RIG FOR DRILLING A SPECIAL NUT.

it could also be fixed in any position by tightening the screw *D*. One end of the spindle *E* was turned down to allow the pronged nut to slip on, the nut being held for drilling by the wing nut. At the other end of the spindle was a knurled knob *F*. The pitch of the screw was drilled. Now turn it back, so as to withdraw the drill. Take the saddle away, and turn *F* to bring the second prong into position for drilling. Run the saddle up against the stop *H* and drill the prong; go through the same operations for the third prong. The turning of knob *F* gives the rotary motion at the same time the screw is putting on the spiral. The reason for *B* being so high is, one pronged nut has to be drilled with its center below the lathe center, and the other nut with its center above the lathe center. The graduations are to save time in setting the spindle *E* to different hights. When the top of *C* is against the zero mark both centers are level. Fig. 3 is a full size view of the spring, which is used as a tension and a compression spring. Fig. 4 is an enlarged view showing the shape of drill to give proper clearance.

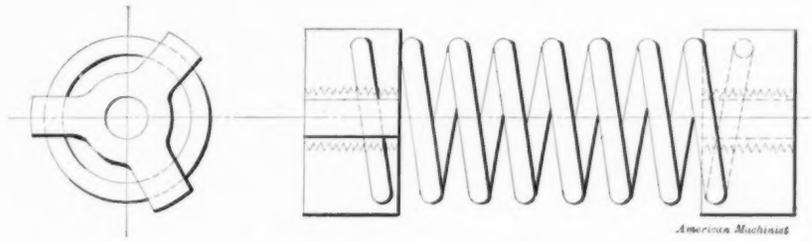


FIG. 3. SPRING AND PRONG NUTS.

Johnstone, Scotland. L. E. W.

Shop Orders.

Editor American Machinist:

I read with much interest Mr. John Randol's article at page 439, particularly his system of order blanks. I think there is one objection to Mr. Randol's system—his record of the order is made after the work is completed and not at the time the order is issued. It seems possible that there are a great many chances of the original order (the only copy of which is given to the workman to follow) becoming destroyed or badly used up.

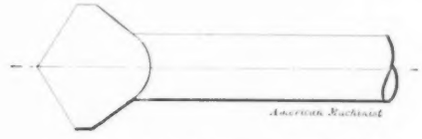


FIG. 4. ENLARGED VIEW OF DRILL.

We have in use here a system similar to Mr. Randol's which has proved very satisfactory. There is this difference, however: at the time the order is issued a copy is made which is retained by the person issuing the order. The order slips are doubled over, having the uppermost portion of the sheet as bound in the pad about ¾ inch shorter than the under portion. The sheets are bound in pads of about 50 and are fastened only by the projection portion of the under part. A perforation is made about ⅝ inch from this end and also on the line where the fold comes. On the top of the pad is fastened a sheet of carbon paper.

In use the uppermost portion of the sheet is pulled out and doubled over the carbon paper, and the order is written on this sheet. This part of the slip is torn out and given to the person to whom

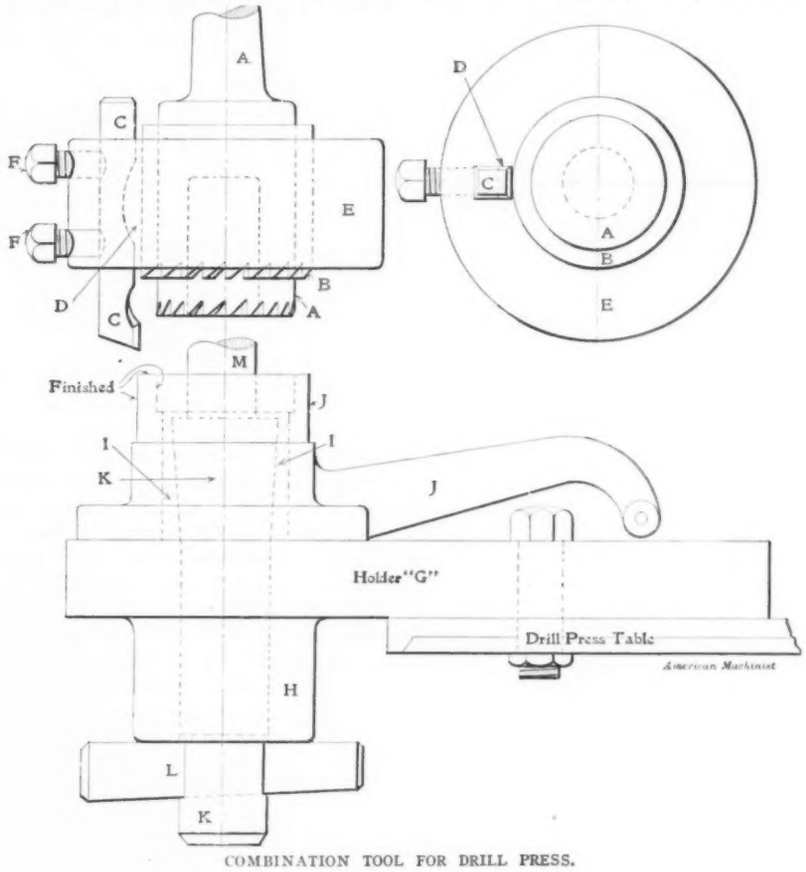
the order is to be issued and the lower part on which there is a carbon copy of the order is also torn out and filed away for reference by the one issuing the order. These pads when in use are carried around in the pocket protected by a removable cover. JOHN L. BACON.

Combination Tool for the Drill Press.

Editor American Machinist:

I send a sketch showing a piece to be machined, a fixture for holding the piece, and a combination tool for doing the work. As the lathes were overworked it was decided to make these tools for the drill press. The results were so satisfactory that all work of this kind is now done in the drill press.

In the sketch, *A* is a mill with a shank to fit drill press spindle, and *B* a shell mill made to fit on *A*. The tool *C*, which turns off the outside of the work, rests on a key or tool block *D*; thus the tool has a very fine adjustment. *E* is a cast-iron collar grooved to receive tool *C*. The mill *B* is split part way down, and is clamped to *A* by set-screws *F* which also hold tool *C* in place. The holder *G*—which is secured to drill press table—is a forging with two hubs, *H* and *I*. Hub *I*, which is



COMBINATION TOOL FOR DRILL PRESS.

turned to fit hole in work *J*, we will call a chuck. It is bored out taper to receive plug *K* and is split so it will expand when *K* is drawn down by key *L*. A steady-pin *M* enters the hole in mill *A* when it is brought down to the work, and a step on the drill press spindle gives the proper depth of cut. TOOL ROOM.

Clamp Hubs.

Editor American Machinist:

In Figs. 1, 2, 3 and 4 are shown examples of clamp hubs for various machine parts, and I hope that the advantages of this way of fastening may appeal to some of your readers who are still addicted to the use of set-screws and taper pins in this sort of work.

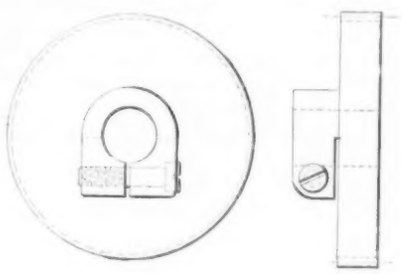


FIG. 1 FIG. 2

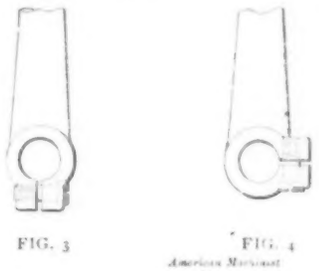


FIG. 3 FIG. 4

American Machinist

CLAMP HUBS.

The clamp hubs give but a very little additional work to the patternmaker and machinist, and are twice as satisfactory as the above-named ways of fastening. There is no set-screw to mar the shaft and cut a groove in it, and no taper pin to work loose and drop out. If a key is desired, it can be used, and the clamp holds just the same.

Ordinarily these small parts do not require more than a simple clamping. As the hole is made to fit the shaft quite snugly and yet go on without trouble, a very little clamping holds the parts quite firmly. Adjustment may be made all around and all along the shaft at any time.

The machine work on the hub in Figs. 1 and 2 consists in sawing it half way through at right angles to the shaft and then parallel with the axis of the shaft down to the hole. Drilling and tapping for the screw and counterboring, if desired, completes it. The screw should fit closely in the tapped hole, so as not to work loose at any time.

TIM HANDYSIDE.

[A variation of the method shown may be seen in the feed screw handles of rock drills, which are ma'e like Fig. 3, except that the handle—or crank—is threaded to the end of the screw which it is to turn. The jar of the machine made this handle a difficult piece to hold in place in the old days and the plan described—due to Jos. C. Githens—is the only one ever devised which answered the purpose. Our contributor's sketches show good design, in that the screw is snug up to the shaft. Many designers place them at a distance, but for no known reason.—Ed.]

A Memory Tickler.

Editor American Machinist:

For those draftsmen who forget constants they should remember, I would suggest that such figures may be scratched on a celluloid triangle with a steel point and be filled in with drawing ink. There are sometimes important but elusive figures that must always be at hand and, it is not a bad plan to so embalm them.

F. W. HARRIS.

If motor cars are ever to be anything but toys for mad millionaires, which they are at present, makers will have to devote their attention to the production of vehicles that will take the place of cabs and carriages, that will not break down continually, and that will not cost a small fortune to keep in repair.—*The Autocar, London.*

The man who invents an airship with a safety clutch and something for it to clutch to will solve the problem all right.—*Washington Post.*

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 464,250 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
Three-Spindle Rail Drilling Machine.	865
Getting Fair Play for Modern Steel.	865
The Gentle Art of Contracting.....	865
Some Points in Shop Practice from the Cincinnati Milling Machine Company.....	866
Echoes from the Oil Country.....	870
An English Micrometer Caliper.....	872
Richard Trevithick—An Unappreciated Inventor.....	872
Legal Notes.....	873
The Federal Electric Blueprinting Machine.....	874
Average Drawing Room Practice.....	874
Special Operations in Making Mills and Counterbores.....	876
Centering Machine.....	876
A Hard Alloy of Copper.....	877
Letters from Practical Men.....878-883	
The Man Who Knows It All.....	884
The Closing of a Unique Record....	884
Joseph Tangye.....	884
The Nine-Hour Day Movement.....	884
The Nine-Hour Day.....	885
International Competition for a Belt Shifter.....	885
The Tenth Annual Meeting of the Society for the Promotion of Engineering Education.....	885
Annual Meeting of the American Association for the Advancement of Science.....	885
Civil Service Examination.....	885
Interview with Mr. Horne on Far Eastern Trade.....	886

The Man Who "Knows it all."

Some time since a man who, though not directly connected with coal-mining operations, is in a position to know considerable about them, was traveling with a man who was in charge of the mines of one of the most important companies. The question of visiting other mines to observe points of practice came up and the mine manager was asked if he ever did this. His reply was: "No, I don't think we have anything to learn from other people about mining anthracite coal, and I have enough to do without bothering with what other people are doing." The person to whom this remark was addressed made up his mind at the time that if ever a change of management came into force in that mining interest this particular man would probably be one of the first to walk the plank, and this mental prediction has recently proved true; new management having put the mines in charge of a trained mining superintendent who doesn't disdain the experience and knowledge of others, but on the contrary is anxious to learn all that he can about what other people are doing in his line of work. The incident is instructive, and it is obvious that it applies to matters of machine construction as well as to the mining of anthracite coal. The man who in these days neglects to ascertain all that he can regarding what other people are doing by reading technical literature and by visiting their works is deceiving himself, and where he has an opportunity to know what others are doing and fails to make use of such opportunity it must be due either to the densest ignorance, to unmitigated egotism or to an utter lack of interest in his business.

The Closing of a Unique Record.

The record is that of the steam locomotive service of the Manhattan Elevated Railway of New York, which is now being superseded by electricity. On two of the four lines of this road the electric motor is already installed, and it cannot now be long before the steam locomotive will have disappeared from the entire system. The record of the running of the trains upon this road is a remarkable one in the one particular at least of the total avoidance of serious accident. We have no figures at hand, and they are not necessary, but the number of passengers carried in a quarter of a century calls for ten figures to record it. Billions have been carried in safety, considerably more than half a million being carried each day. It is not luck that has made the record, but correctness and general reliability at every point. We are inclined to think that, above all others, the men most deserving of recognition and remembrance in this connection are those who have operated the locomotives. Of the half a hundred of engineers in service it has been possible for any one of them on any day to have caused a collision or a derailment or other "accident" that could have caused loss of life or serious injury to many; and none of this has occurred, although the men are no more than human. The mere statement of their record is all that is required to constitute high praise. The men may be proud of themselves and of each other. While we are speaking of the engineers we are not forgetting the firemen, who have co-operated in the continued success.

The discarding of the steam locomotive was of course inevitable, and the management of the road has incurred severe censure for its delay in making the change. Many things will follow the change, the most pronounced probably being in the reduction of the operating expenses. The company must of course be the gainer, and the public hope to be, but with them there are possibilities of disappointment. It is not easy to see much to be gained in either the speed or the frequency of trains, as these are dependent largely on other things than the motive power. The most serious thing with which the public is likely to come in contact is in the change of personnel at the head of the train. The motor can be operated by a cheaper man than can the locomotive, and the cheaper man will inevitably get there. One man can do all that is required, so far as working the levers is concerned, but in the case of these trains it is a serious thing to have only one pair of eyes and of ears where before there were two. We are not prophesying disaster, but it will be well to remember the old-time engineers and firemen and to continually regret their loss.

Joseph Tangye.

The death of Joseph Tangye, of Birmingham, England, took place on the 4th inst. He was one of the famous Tangye brothers, and to him are to be credited many of the most important improvements that have been made in British mechanical engineering practice during the past fifty years. His firm was appealed to when the "Great Eastern" refused to "glide" into the water, and they did the work by means of hydraulic jacks. *The Engineer* in announcing his death says that "many of the appliances now claimed as American improvements were solely the result of his effort," which, if true, shows very clearly how much Joseph Tangye was in advance of most of his countrymen.

The Nine-Hour Day Movement.

IN WORCESTER.

There are unmistakable signs that strikers are weakening, although there has not as yet been a general move on the part of the strikers to secure the old positions. Many of the "outs" would be only too glad to go back to work but for the opprobrium attached to such action and the strenuous persuasions of strike leaders. Among the smaller concerns affected by the strike the report is that there has been

little difficulty in *engaging* new men to take strikers' places, but such men are apt to fail to show up.

The Metal Trades Association have standing advertisements in the Worcester dailies which bring in a number of men from outside the city, who report at the association headquarters and are then assigned to the members' shops that are in most need. F. E. Reed Company have 160 or more men at work to-day.

At the shops of Prentice Bros. Company they seem to be yet at a deadlock. Matters have progressed so far as a conference between the gang bosses and the officers of the company which was productive of no definite result, except to indicate that the leading class of men are tired of the strike. A meeting planned to be held at Prentice Bros.' shop by a large number of their old workmen was frustrated by the vigilance of the strike leaders.

That the Worcester strike was ill-advised is now generally admitted. It is now thought that the plan of campaign was for a strike only in one or two of the largest shops, where the chance of success seemed greatest, and it was understood that government and other contracts signed by these concerns (with large forfeiture clauses) would force them to surrender. What the men did not realize is that the fulfillment of such contracts is usually made contingent on *strikes* and visitations of Providence.

Then, too, the action of the manufacturers in forcing the strike in other shops was unexpected, and the working union men, instead of being contributors to help support the idle men, became in turn pensioners of the union. O.

Worcester, June 14.

IN CHICAGO.

The machinists' strike at the Chicago works of the Allis-Chalmers Company—namely, the plants of the Gates Iron Works and of the Fraser & Chalmers Company—was settled this week, effective June 16. The strike was inaugurated May 30, 1901, and was therefore in force over a year. The men are conceded a shorter number of hours and a basis of wages mutually satisfactory. Strikes at four other shops in Chicago were also begun over a year ago and negotiations are now in progress to end two of these in the immediate future. M.

Chicago, June 14.

The Nine-Hour Day.

The June number of the *Machinists' Monthly Journal* mentions the following machinery building concerns as having granted a nine-hour workday to their men within the past month:

The De Laval Separator Company, of Poughkeepsie, N. Y.

The Worthington Pump Company, Brooklyn, N. Y.

The Blake Pump Works, Boston, Mass.

Marine Engine Company, Chicago, Ill.

McMullin Manufacturing Company, Chicago.

Morgan Electric Company, Chicago.

Tiegen & Lang, Hoboken, N. J.

Denver Engineering Works, Denver, Colo.

International Competition for a Belt Shifter.

There is a law in France which forbids the putting on or throwing off of a belt while the machinery is in motion. The strict enforcement of this law of course entails numerous stoppages, and to obviate this loss of time an association of French manufacturers has announced an open international competition for the invention of a fixed belt mounter. The device desired is for plain pulleys and not for cones, and must comply with the following enumerated conditions: (1) It must be simple, strong, and occupy little space—easy to fix and use; (2) not dangerous in working; (3) convenient for any speed, width or position of belt; (4) able to throw the belt off and on; (5) sufficiently low in price to allow of its wide use. Competitors are invited to send a full description of their invention, accompanied, if possible, by a model or at least by satisfactory illustrations, to the president de l'Association des Industries de France contre les Accidents du Travail, No. 3 rue Lutèce, Paris, prior to October 1, 1902.

The Tenth Annual Meeting of the Society for the Promotion of Engineering Education.

The annual meeting of the above named society will be held June 27 and 28 in the lecture hall of Carnegie Institute, Pittsburgh. Papers and reports are to be read upon the following subjects: President's address—"The Efficiency Factor in Engineering Education," by Robert Fletcher, Director of the Thayer School of Civil Engineering, Dartmouth College. "The Needs of Engineering Colleges," by N. Clifford Ricker, Dean of the College of Engineering, University of Illinois. "The Value of Non-resident Lectures on Engineering Subjects—a Discussion," by William D. Pence, Professor of Civil Engineering, Purdue University; George F. Swain, Professor of Civil Engineering, Massachusetts Institute of Technology; Robert H. Thurston, Director of Sibley College, Cornell University; Palmer C. Ricketts, President and Director, Rensselaer Polytechnic Institute. "Methods of Grading Students in Engineering Colleges," by Charles P. Matthews, Associate Professor of Electrical Engineering, Purdue University. "The Subdivision of the Field of Chemical Engineering Education," by Edward Orton, Jr., Professor of Ceramics, Ohio State University. "Electrochemistry as an Engineering Course," by Charles F. Burgess, Assistant Professor of Electrical Engineering, University of Wisconsin. Report of the Committee on Technical Books for Libraries—Charles F. Burgess, Chairman. "Courses of Instruction in Irrigation Engineering," by Elwood Mead, Professor of the Institutions and Practice of Irrigation, University of California; Expert in charge of Irrigation Investigations in the United States Department of Agriculture. "Laboratory Notes and Reports," by Francis C. Caldwell, Professor of Electrical Engineering, Ohio State University. "Some Abuses of the Lecture System—a Discussion," by Arthur W. French, Professor of Civil Engineering, Worcester Polytechnic Institute. Report of the Committee on Statistics of Engineering Education—William F. Magruder, Chairman. "Management of College Athletics," by Calvin M. Woodward, Dean of the School of Engineering, Washington University. "Over-development in Engineering Laboratory Courses," by Frederick P. Spalding, Professor of Civil Engineering, University of the State of Missouri. Report of the Committee on Entrance Requirements for Engineering Colleges—Harry W. Tyler, Chairman; John J. Flather, Secretary.

Annual Meeting of the American Association for the Advancement of Science.

The fifty-first annual meeting of the above association will be held at Pittsburgh, Pa., June 28 to July 3. The opening general session will be at 10 A. M., June 30, in the Music Hall of the Carnegie Institute. The meetings of section D, Mechanical Science and Engineering, will be held in the lecture room of the First United Presbyterian Church, and those of section B, Physics, will be in the middle room of Carnegie Lecture Hall. The Society for the Promotion of Engineering Education will hold its fourteenth annual meeting in the west room of Carnegie Lecture Hall, Carnegie Institute, June 28 and 30. A reduced fare of one and one-third for the round trip on the certificate plan has been arranged for as usual.

Civil Service Examinations.

The United States Civil Service Commission, Washington, D. C., announces the following examinations to be held at various places throughout the country: July 8, 9, watch officer, Coast and Geodetic Survey; July 8, 9, 10, deck officer, Coast and Geodetic Survey; July 10, laboratory assistants, National Bureau of Standards, $900, $1,000 and $1,400 a year; July 11, 12, aid, Coast and Geodetic Survey, $720 a year; July 15, 16, assistant (piece work computer), Naval Observatory and Nautical Almanac Office.

J. C. Stewart, the American contractor, whose record bricklaying performance in connection with the erection of the British Westinghouse Electric & Manufacturing Company's works at Manchester, England, recently caused so much discussion, has been engaged by the Midland Railway Company to supervise and expe-

dite the work at the mammoth Midland Railway Hotel at Manchester. The contract is in the hands of Messrs. William Brown & Son, of Salford, England, and it is said that they are to receive $100,000 in bonuses if the work is finished within a year, and $10,000 a month for each month shorter than that time. The total price is $5,000,000.

By a decision recently rendered in one of the Ohio courts the employees of the Cincinnati Safe and Lock Company, who owned stock in the concern at the time it went into the hands of a receiver, will be paid wages regardless of the fact that they were stockholders. It seems that when this company failed it owed wages to a number of stockholders and the men put in claims as workmen. The receiver denied the claims on the ground that the men were also stockholders, but the decision upholds their claim as workmen independent of their interest in the concern as part owners.

It is announced that Col. Pope, of Hartford, is now in a position to dictate the policy of the American Bicycle Company and that this means some important changes in its methods. It is understood that Col. Pope has the support of John D. Rockefeller, who has recently become a large holder of A. B. Co. stock.

The office of the National Metal Trades Association has been removed from 95 Liberty street, New York, to 50 Mitchell Building, Cincinnati, Ohio.

Personal.

Cady Staley, for sixteen years president of the Case School of Applied Science, Cleveland, has resigned in order to retire from active school work and engage in travel.

Chas. A. Rossberg, who has been with the Russell & Erwin Manufacturing Company, New Britain, Conn., as chief draftsman, is now with the Comptograph Company, of Chicago, in a similar capacity.

George Paroschol, of Athens, Greece, who was graduated in June from the Massachusetts Institute of Technology, has enrolled in the American School of Correspondence, of Boston. Mr. Paroschol expects to complete the School's course in the fall when he will return to Greece to accept an engineering position under the government.

Mr. R. C. Handloser, who for some time past has been doing missionary work abroad for Brown & Sharpe in connection with Diechmann & Son, of Berlin, has returned to this country and has gone into business with his father, Thomas V. Handloser, at 124 East 129th street, New York, where they are operating a machine shop for tool and repairing other special machinery and tools.

Interview with Mr. Horne on Far Eastern Trade.

We have already mentioned the visit in this country of F. W. Horne, of Yokohama, prominent in the American machinery and tool trade in different countries of Eastern Asia. Upon his arrival, Mr. Horne promised to tell the AMERICAN MACHINIST something about machinery trade conditions in that part of the world, and, having now disposed of a number of orders which he was at first engrossed in placing, he speaks to the following effect:

The Japanese market for machinery is rather depressed, but Mr. Horne has been fairly fortunate in securing orders, some good-sized ones going to swell the total. There are not a great many public works to depend upon at present. It is possible that the government may build an armor-plate plant, but the lack of adequate appropriations to support the steel works it has already constructed tends to level prospects down to a mediocre basis. It is likely the Japanese market will be held for those American machine tools in which the greater part of the cost is due to the labor rather than to raw material. The English, on the other hand, enjoy an advantage in such lines as power shears and hammers. Price, naturally, is a material consideration. Yet that it is not the supreme consideration may be judged from the inferior standing of German tools in the Far East. Mr. Horne is little worried about these, however low the price. Even if a tool built in Germany after American design be very well made, the buyer would rather look to the United States for the real thing.

Two or three parties in Japan are copying certain lines of American tools. Mr. Horne sold both the machines which serve as models and those used in the construction of the imitation. He regards the disposition to build machine tools in Japan as of comparatively little significance.

Manufacturers who wish to do business in Japan under the reputation they have acquired elsewhere, or who do not want anyone else to use their reputation for his own purposes, would do well to register their "Chop"—that is to say, trade-mark. In case they fail to do this and someone else does it on his own account, he may acquire the exclusive right to use the mark, leaving them without redress. It is to be borne in mind that proper names are trade-marks under this category, since the Japanese can hardly appreciate the difference between a patronymic and a fanciful title in a strange language. The cost of registering a trade-mark in Japan is not over $50. Mr. Horne holds the "Chops" in that country for many of the companies for which he is agent. The need of registering trade-marks is true also in China, not to say, however, that the laws there are quite the same as in Japan.

In regard to the opportunities for American machinery in Siberia, Mr. Horne states unequivocally that the market has been killed by the well-known retaliatory duties and that there is no prospect of a revival while those rates remain in force. There is a great deal of feeling on the subject, but even if there were not, the tariff would be an insuperable barrier to the importation of any great quantity of our machinery.

In China there is little demand for machine tools. The effect of the war thereupon has been prejudicial, if anything, and it need not be expected to be beneficial during this generation at least.

In Manila, Mr. Horne has a partner and his firm is doing quite a business there in supply lines—more particularly in building material. The demand for machine tools there is limited. Quite a number of electrical plants are being put in for lighting purposes. The industrial future of the islands, Mr. Horne thinks, will wait upon the results of the manual training schools that are being established. The past occupations of the Filipino have been cock-fighting, playing on the mandolin, sleeping and eating. Mr. Horne is of opinion that what is imperatively needed is the immigration of Chinese laborers. These make good mechanics and through intermarriage with the Filipino women will supply an element to the population which will render it capable of industrial progress. Nobody will take the place of these Chinese in the development of the islands.

One point which Mr. Horne brought out with some emphasis is, that many American manufacturers do not sufficiently protect their agent. After he has worked up business for them they will ship goods into his territory in derogation of the contract and without compensation to him. When their attention is called to the fact they profess ignorance as to the destination of the goods. Such people may be put in one or the other of two classes: Those who do not know because they do not wish to know, and those who really do know but prevaricate. There is not a respectable export house in the city which would refuse to let its clients know the destination of their goods if they demanded the information. The blame for infidelity to agents, Mr. Horne says, attaches to more manufacturers of prominence than he would care to mention.

Mr. Horne holds a long list of agencies—some thirty now in all. Two of those recently taken are the Brown & Sharpe Manufacturing Company's, for machine tools in the Far East, and the Warner & Swasey Company's, for that region. He proposes to take up a new line of stocks, taps and dies and one of large machine tools. It may be mentioned that Mr. Horne holds the agency for L. S. Starrett Company's small tools.

While in this country he has been placing orders for a quantity of electrical and other equipment of fifteen cruisers, which will be constructed for the Insular Government of the Philippine Islands to navigate the rivers and other waters of the archipelago. These are to be screw steam-

ers with English compound engines. The orders placed by Mr. Horne cover a 10-kilowatt General Electric lighting set for each; a like number of 18-inch projectors from the same company, with diverging lense; forty-two Laidlaw-Dunn-Gordon duplex steam pumps; centrifugal circulating pumps of the Morris Machine Works; a quantity of boiler appliances, etc.

There have just been shipped to the Nagasaki Dock Company a carload of William Sellers & Co.'s heavy tools; a carload of Brown & Sharpe milling and screw machines. Three 5-foot radial drills have been ordered for the Uraga Dock Company. Another Japanese order specifies an outfit for making clocks. Three carloads of Atlas engines have gone forward for Tokio, Yokohama and Foochaw, and a J. A. Fay & Egan sawmill outfit for the last-mentioned place.

Commercial Review.

NEW YORK, Monday, June 16.

LATHE BUILDERS ORGANIZE.

A meeting was held at the Waldorf-Astoria Hotel in New York last week which was attended by most of the prominent lathe builders of the country, and at which meeting an agreement was arrived at to advance the prices of lathes 10 per cent. The meeting was called by William Lodge, of Cincinnati, who, after conferring with several prominent builders and getting their approval of the plan, issued invitations to some twenty-eight builders of lathes, and the result was a conference at which an enjoyable time was had, and in which an understanding was arrived at among the various builders, which it is thought will be beneficial and will tend to remove some of the abuses which have characterized the business. Mr. F. E. Reed, of Worcester, was elected president of the organization, and there is provision for an annual meeting, with such additional meetings from time to time as may be called. The object of the association is to discuss matters of mutual interest, such as the relations of builders to sales agents, the handling of foreign trade, prevention of price cutting, etc. It is pointed out that during the past year labor has in some cases, and probably in most cases, advanced about 20 to 25 per cent., and some materials have advanced even more than that—steel, for instance, which a few years ago was selling at .9 cent per pound being now sold at 2⅜ cents per pound. It is on this account agreed among the lathe builders that a 10 per cent. advance in price is fully warranted. This increase, we understand, they have decided to make in the next thirty days, in the meantime declining to accept stock orders at previous prices. The Niles-Bement-Pond Company was not a participant.

MACHINE TOOLS FROM GERMANY?

In return for the way in which the German users of machine tools tided us over our years of depression by importing from America, would it be a graceful act on our part if we were to buy German tools to help tide the German builders over their depression? That such a thing could take place with our 45 per cent. tariff has hardly been considered possible, but there are indications that even the present tariff wall is not insurmountable. At least so believes a man who is well posted upon tool building in Germany and who remarks as follows: "The present unprecedented wave of prosperity is bringing about a development that a few short months ago would not have been considered within the bounds of possibility. It is easily within the recollection of all readers of this paper that our machine-tool builders were tided over very serious times by their export trade to Europe, especially to Germany. The good times prevalent there at that time and the very low or practically non-existent duties aided American builders. It would seem that at least one important German firm is of the opinion that there is a possibility to-day of return in kind.

"Our 45 per cent. tariff is naturally an almost prohibitive handicap; that may, however, not be quite as serious as it appears at first sight, if it is taken into consideration that trade abroad is so low that in order to keep going makers are glad to get orders for practically the cost of labor and material. The German Niles Tool Works Company, whose model plant was described in your paper, Vol. 24, Nos. 20, 21 and 22, builds quite along American lines as to design, having in fact acquired their designs from the American company. It is extremely unlikely that with our present tariff the possibility of importation will be more than an incident, passing away with a slight slowing down of the present demand here and improvement of business conditions there. American builders can therefore view this development without alarm and regard it rather as a sidelight thrown on the high-water mark of the present tide of prosperity here."

MISCELLANEOUS.

The new shipbuilding trust mentioned last week has rapidly taken shape. Its proposed constituency has resolved itself into the following: Union Iron Works, San Francisco, Cal.; Bath Iron Works, Limited, and the Hyde Windlass Company, Bath, Me.; Crescent Shipyard and the Samuel L. Moore & Sons Company, Elizabethport, N. J.; Eastern Shipbuilding Company, New London, Conn.; Harlan & Hollingsworth Company, Wilmington, Del.; Canda Manufacturing Company, Carteret, N. J. It is to be called the United States Shipbuilding Company. A prospectus has been issued showing that the capital stock will consist of $10,000,000 preferred and $10,000,000 common stock. Five per cent. 30-year gold bonds to the amount of $9,000,000 will be offered to the public. Further, it is just announced that the new concern has bought the Bethlehem Steel Company. This denotes that it will be able to build and equip a battleship complete and also that it will be operated in harmony with the Morgan interests. In consequence of the purchase the capital stock of the United States Shipbuilding Company will probably be made considerably larger than the amount above mentioned.

Recently there have been made public the annual reports of some of the most important American engineering companies. The International Steam Pump Company preliminarily reports net profits after all deductions for depreciation and other charges for the year ended March 31 of $1,510,468 applicable to dividends. These figures compare with $1,772,632 as the net earnings a year ago before entered charges of $247,000 were deducted. After

MACHINERY, MACHINES, AND PARTS OF—	APRIL—				TEN MONTHS ENDING APRIL—					
	1901		1902		1900		1901		1902	
	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.
Cash Registers	937	71,738	1,942	166,947	.....	684,224	10,969	809,044	11,298	980,451
Electrical Machinery	.....	526,824	.....	538,118	.....	3,295,630	.....	4,805,030	.....	4,534,219
Laundry Machines	.....	51,944	.....	75,461	.....	343,007	.....	376,243	.....	449,812
Metal-working	.....	268,587	.....	204,974	.....	6,001,731	.....	3,527,086	.....	2,604,664
Printing Presses, and parts of	.....	67,130	.....	50,594	.....	1,001,443	.....	904,702	.....	681,519
Pumps and Pumping Machinery	.....	193,298	.....	151,195	.....	2,614,244	.....	1,873,513	.....	1,720,597
Sewing Machines, and parts of	.....	300,067	.....	397,677	.....	3,722,670	.....	3,444,189	.....	3,258,056
Shoe Machinery	.....	69,425	.....	49,580	.....	1,007,434	.....	764,761	.....	836,267
Steam Engines, and parts of—										
Fire	.....	.....	.....	.....	1	8,135	11	18,470	9	24,456
Locomotive	28	205,300	38	420,871	451	4,805,375	343	3,282,753	324	2,931,767
Stationary	219	78,375	114	67,458	916	517,164	1,093	780,517	918	634,858
Boilers and parts of	.....	103,909	.....	147,076	.....	1,436,021	.....	1,403,478	.....	1,433,280
Engines	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Typewriting Machines, and parts of	.....	257,446	.....	388,150	.....	2,257,872	.....	2,335,446	.....	2,706,759
All other Machinery, and parts of	.....	1,580,957	.....	2,319,768	.....	17,797,291	.....	17,557,669	.....	17,222,575

UNITED STATES EXPORTS OF MACHINERY OF DOMESTIC MANUFACTURE, INCLUDING APRIL, 1902.

allowing for this deduction it will appear that the earnings in both years were almost the same. The Cramp Ship & Engine Building Company's report shows an increase in net earnings for the fiscal year ended April 30 of $93,474 over the previous one. The company has unfinished work in hand amounting to $12,811,000. The Allis-Chalmers Company, which was incorporated May 7, 1901, made net profits from the beginning of its business up to April 30, 1902, amounting to $1,442,259.51. This figure allows for all expenses of manufacture and selling, with full provision for depreciation of buildings, plant and machinery and for possible bad debts. Orders in hand and unfinished April 30, 1902, amounted to $8,157,034.75, while those on hand and turned over to the company on its commencement of business were $5,665,882.13. The gain in volume of business is therefore $2,491,152.62.

Control of the Stanley Electric Manufacturing Company, Pittsfield, Mass., has been bought by William C. Whitney, Thomas F. Ryan, Thomas Dolan, William L. Elkins and P. A. Widener. The company has a capital of $2,000,000. Through the new ownership the concern becomes affiliated with leading traction companies of New York and Philadelphia, and it is naturally supposed that the deal has been made with the intention of using the Stanley company to manufacture supplies for the roads controlled by the magnates named. It is also rumored that the plant is to be increased and extended by the aid of Ganz & Co., one of the big electrical concerns in Europe, for the purpose of converting steam railroads in this country into electrical roads.

There are reports current that steps are being taken to bring about a consolidation of the Mergenthaler Linotype Company and the Lanston Monotype Company. This matter was under discussion some months ago, and now the talk is revived.

The Toledo Machine & Tool Company is shipping to Western Pennsylvania what it regards as probably the largest machine ever made in Toledo, Ohio. This is a punch press weighing, with the special attachments, more than 100,000 pounds. The company has perfected a number of machines for the special use of manufacturers of shovels by which, it is stated, the labor cost in this line of manufacture is very greatly reduced. Within the last two years the company has furnished the equipment for some twenty shovel establishments.

The L. W. Pond Machinery & Foundry Company has been incorporated in Maine, the formal seat of organization being Portland. It has a capital stock of $90,000. The president and treasurer is Caleb Calvin, of Worcester, Mass.

The firms of C. C. Bradley & Son and The Bradley Company, Syracuse, N. Y., manufacturers of carriage hardware specialties and the Bradley power hammer respectively, have purchased three acres of land on North Franklin street, in that city, on which to erect a new factory. These concerns are practically one and the same, although run under different names. They expect to begin building this fall, and will erect a main building 310x80 feet. A part of this building, 40x80 feet, will be three stories in hight and the machine shop 240x80 feet. There will be one or two traveling cranes with a span of 25 feet each running the entire length of the machine shop. They will also erect a forge shop 50x100 feet, also an engine and boiler room, coal bunkers, lunch and locker room, storage sheds, etc. The lease of their present building expires August 1, 1903.

The Philadelphia Pneumatic Tool Company is now settl d in its new shops at Twenty-first street and Allegheny avenue, Philadelphia. The works are being run night and day to catch up with orders delayed by moving. Recent large orders have been received from the Southern Pacific Company, Newport News Shipbuilding & Dry Dock Company, Pennsylvania Railroad Company, Lackawanna Steel Company, and others.

The General Electric Company has filed a certificate increasing its capital stock from $25,242,200 to $45,000,000.

The Otis Elevator Company, 71 Broadway, New York, has established a company in Canada. It has plans made for a works in Hamilton, Ontario, and has purchased the greater part of the tools from Canadian makers. It has a small plant at Montreal, where it expects to do certain repair work, but the main works it has practically decided to locate at Hamilton.

The cost of the electrical equipment of the New York subway will be $18,000,000, it is said, instead of $7,000,000 as originally estimated by the experts. The difference is attributed to the advances in electrical science.

Following Boston and New York, a subway scheme is being agitated in Chicago. Former Mayor Hempstead Washburne, William A. Alexander and S. S. Gregory are the promoters.

The Dodge Manufacturing Company has recently contracted to furnish the Ansonia (Conn.) Brass & Copper Company with a 400 horse-power rope drive, which will involve the transformation of a balance wheel on an engine into a grooved wheel by putting on a hardwood lagging. The first named company will also install a complete rope drive outfit for the Russell, Burdsall & Ward Bolt & Nut Company, Portchester, N. Y.

The Thornton Machinery Company, of Providence, R. I., has just been incorporated to do a general agency business in machine tools and supplies, engines and boilers and second-hand machinery, and has taken quarters at 21 and 23 Exchange Place. J. T. Thornton, formerly of the A. B. Pitkin Machinery Company, and well known among the trade, is at the head of the new company.

The Lackawanna Colliery at Olyphant, Pa., and the North Western Colliery at Carbondale, Pa., are to be equipped with forced draft apparatus furnished by the American Blower Company, of Detroit, Mich. Large steel-plate fans driven by direct-connected engines of the marine type are to be installed.

The prosperity in engine building is illustrated by the fact that the new Brown-Corliss Engine Company, whose large shops are located at Western Union Junction, near Milwaukee, Wis., but whose general offices are in the Matthews Building of that city is already contemplating the erection of a number of additions to keep up with the rush of business that has besieged the firm since it has opened.

Contracts are being awarded for a part of the new rolling mill to be erected at East Youngstown, Ohio, by the Youngstown Manufacturing Company. The contract for a large compound engine went to the William Tod Company, of Youngstown, while a contract for another engine was awarded to the Buckeye Engine Company, of Salem.

According to a report from Consul-General Bittinger at Montreal, there are eighteen rolling mills and steel works completed in Canada. Of these, one makes steel in a special Bessemer converter, one makes Tropenas steel, and four make open-hearth steel, while two standard Bessemer steel plants and one open-hearth steel plant are being built. The annual capacity of all plants is: Standard, Bessemer, Tropenas, and special Bessemer ingots and castings, 301,400 gross tons; open-hearth ingots and castings, 537,000 gross tons; total ingots and castings, 838,400 tons; rolled products, 981,900 tons. The Canadian pig-iron production for 1901 was 244,976, against 86,090 in 1900 and 94,077 in 1899. The building of new plants insures a great increase this year. Canada does not yet produce nearly enough for home wants, which are estimated at 800,000 tons a year. She exported in 1901 5,623 tons.

CHICAGO MACHINERY MARKET.

It is the common report of sellers of machinists' supplies in the West that trade this month is showing some decrease as compared with a few months ago. This quieting condition is felt to different degrees by Chicago houses and those that experience it to the lesser degree say they expect a more decided decline in volume to come next month. But the above statement should be supplemented by the further remark that business as compared with that of previous Junes is wholly satisfactory.

And there are a few large supply concerns that have not felt the summer lull as yet. One of the largest sellers of emery wheels in this city remarks that with him May broke all records and that June prom-

ises to outdo its predecessor. This activity is partially accounted for by the fact that deliveries of emery wheels, in at least some instances, are backward and that the user is obliged to be forehanded, if he wishes the supplies when needed. In lines of supplies where shipments are prompt, there is not the same earliness of ordering.

Concerning the users of machinists' supplies in the West it may be said that as a rule the shops are running at full capacity. A salesman who mingles freely with buyers for machine shops says that a complaint of business is unknown among the larger corporations. The latter are overrun with orders and are sold so far ahead that the beginning of the end is not discernible. Among some of the smaller and comparatively unknown shops, there is not jubilation just now, and it takes some hustling perhaps to keep the industrial pot boiling, but it is not said by these less fortunate manufacturers that business is dull; they only say it is not booming. The fiscal year of many Western concerns, like the implement makers, expires June 30, and they are endeavoring to reduce supplies for the annual stock-taking wherever practicable, though when prompt shipment of supplies is not to be depended upon they have already placed large orders for July deliveries.

The Chicago Pulley and Shafting Company, 51 South Canal street, who have just started in business, report demand larger than they can fill, owing to delays in obtaining stock.

Among recent orders of the Chicago Pneumatic Tool Company have been an equipment for the Fore River Ship and Engine Company, and a large duplicate order from the Standard Steel Car Company, Butler, Pa. Makers of pneumatic tools report business increasing rapidly, and reasons for the same include the natural growth of manufacturing, a more extensive application of this method of power and a more extensive use of the old applications. At present the most inviting field for extensions of trade is abroad, where the use is much more restricted than in the United States.

Quotations.

NEW YORK, Monday, June 16.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$21 15	@$21 65
No. 2 X	20 65	@ 21 15
No. 2 plain	20 15	@ 20 65
Gray forge	19 65	@ 20 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	20 25	@ 21 25
No. 2 foundry, or soft	19 75	@ 20 75
No. 3 foundry	19 25	@ 20 25
Foundry forge, or No. 4	18 25	@ 19 25

Bar Iron—Base sizes—Ordinary refined brands, mill price on dock, 1.93c. @ 2.03c. in carload lots. Smaller quantities from store, generally 2.15c. upward.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 29¾c.

Pig Lead—4.10 @ 4⅛c., in 50-ton lots.

Spelter—New York delivery, 4⅞ @ 5c.

Antimony—Cookson's, scarce at 10½c. in a small way, though a lower price is also quoted nominally at least; Hallett's, 8¼c. or a trifle less; U. S., 8⅛ @ 8¼c.; various brands, 7¾c.

Lard Oil—Prime City, 79 @ 81c. in wholesale quantities.

Manufacturers.

The Cary Lumber Company's plant, Cary, N. C., has been burned.

McRea & Hardeman will erect a shingle mill at Maple Falls, Wash.

The Farmers' Manufacturing Company, Sebring, O., is adding a 25x60-foot foundry.

The Clark-Fork Coal Mining Company, of Gebo, Mont., intends to add new machinery.

A. F. Maulhardt is developing a pumping irrigation system 2½ miles east of Oxnard, Cal.

The Clinton Knitting Company, Syracuse, N. Y., plans to erect a factory building this season.

H. L. Goodwin, of Chehalis, Wash., will erect a sawmill of 20,000 feet daily capacity at Cowlitz.

F. K. Drake is soliciting funds for a new sawmill at Aberdeen, Wash. He expects to raise $40,000.

The Merritt Manufacturing Company, woodworking machinery, Lockport, N. Y., will erect a new plant.

A complete electric plant is to be installed by the Mineral Hill Mining Company, Conconully, Wash.

It is reported from Santa Barbara, Mex., that the Montezuma Lead Company will erect a 240-stamp mill.

Work has been started on a $200,000 addition to the S. Severance spike and rivet works at Glassport, Pa.

The contract has been let to build an addition to the Empire Knife Company's factory in Winsted, Conn.

Work will soon be commenced on a new plant of the Louisville Lead & Color Company, Louisville, Ky.

The A. H. Nilson Machine Company, of Bridgeport, Conn., has purchased a site where it will erect a plant.

The Woonsocket (R. I.) Electric Machine & Power Company will add to its powerhouse and power plant.

The Cleveland Burial Case Company, manufacturer of caskets and trimmings, Cleveland, O., will erect a factory.

The Lewis Manufacturing Company, planing mill, etc., Bay City, Mich., expect to rebuild their burned factory.

J. W. Harned & Bro., Adams, Tenn., manufacturers of axe handles, etc., will locate their factory in Hopkinsville, Ky.

The plant of the Altoona (Pa.) Burial Case Company has been badly damaged by fire, and the machinery may be useless.

A disastrous fire has occurred at the plant of the Illinois Car & Equipment Company in Hegewisch, a suburb of Chicago.

The proprietors of the Hamburg (Pa.) Knitting Mills, destroyed on Memorial Day by fire, will erect a two-story factory.

The Huber Printing Press Company, Taunton, Mass., will build a new plant. The first building erected will be 75x 600 feet.

The A. Leschen & Sons Rope Company, St. Louis, Mo., has taken out permits for the construction of a warehouse and factory.

The Sauquoit Silk Manufacturing Company, Philadelphia, Pa., has bought four acres on which it is proposed to build a new plant.

Excavation for the Globe-Wernicke Company's factory in Stratford, Ont., has begun. The building will be 262x60 feet, three stories high.

Work is about beginning on an addition for the Amazon Knitting Company, Muskegon, Mich., to be used as a bleaching department.

The Toledo (O.) Railways & Light Company will construct large repair shops eventually, although arrangements have not been made.

The City Council, San Diego, Cal., has ordered the Water Committee to report on the cost of additional machinery for the pumping plant.

The Ford Manufacturing Company, Chicago, Ill., is considering the erection of a new roofing paper factory at its works at Vandalia, Ill.

The Atlantic Refining Company, Philadelphia, Pa., has taken out a permit to build a pump-house, 52x32 feet, at its works, at Point Breeze.

Steppuhn Brothers, of Baku, Astrachan, Russia, a German firm, purpose the erection of a complete cotton seed oil mill in the vicinity of Baku.

The Louisville (Ky.) Bolt & Iron Company has decided to build a $100,000 iron and steel sheet mill, which it hopes to have in running order before fall.

The Bruening Cork Company is having plans made for an addition to its plant at Oakdale, Pa. The new part will be 60x125 feet, four stories.

C. S. Hartman, of the Auto-Vehicle Company, has purchased the plant of the Pasadena (Cal.) Machine Company and will move it to Los Angeles.

The Lockwood Cutlery Company, of Chelsea, Mass., will move to Lynn, doubling its present capacity for the manufacture of knives and razors.

The Otis Elevator Company has purchased the business and plant of Leitch & Turnbull, Hamilton, Ont., and will open a branch manufactory in that city.

The Hoosier Milling Company is figuring on building a 500-ton concentrator at Lordsburg, N. M. B. L. Berkey, of El Paso, Tex., is promoting the enterprise.

An electric plant will be installed at the Mohican M. & M. Company's mine in Tuolumne County, Cal. Office, 300 California street, San Francisco.

The Main Belting Company, manufacturer of cotton belting, Philadelphia, Pa., is about to erect a four-story factory building at Nos. 1217-37 Carpenter street.

Ground has been broken for additions to the printing press works of Walter Scott & Co., Plainfield, N. J. One building will be 200x60 feet, three stories.

John T. Woodside, of Greenville, S. C., and J. D. Woodside, who has been living in Gainesville, Ga., are prime movers for a new cotton mill at Greenville.

The John Bertram & Sons, Dundas, Ont.,

contemplate further extensions to their plant and at the present time are erecting a new steel frame molding shop.

Wm. V. Lockwood, of the Santa Paula (Cal.) Electric Lighting Company, announces that operations will begin immediately on the plant of the new company.

The United Verde C. Company, which is now putting oil furnaces in its smelting works at Jerome, Ariz., will later on place them in its Iron King mine.

The John Davis Company, plumbers' supplies, etc., Chicago, will occupy a group of buildings to cost $200,000, one of which will be 256x167 feet, four stories.

The management of the Merchants' Light Company, York, Pa., expects to add two more machines to the plant, one of 350 kilowatts and another of 150 kilowatts.

The Reed Manufacturing Company, anti-rust tinware, Newark, N. Y., has bought land on which it is proposed to erect a new factory valued at about $40,000.

Contracts have been let for a six-story factory, 76x91 feet, to be built at 176 Mather street, Chicago, Ill., for the American Cutlery Company, at a cost of $30,000.

The by-law to grant $50,000 to the Deering Harvester Company for a new factory at Hamilton, Ont., fell short by a thousand votes of the required majority.

The Lebanon Textile Company at Avon, Pa., is making arrangements to erect a two-story factory, 200 feet in length, to be equipped with modern machinery.

The Roe Stephens Manufacturing Company, Detroit, Mich., manufacturer of valves, and brass foundry, has purchased land on which additional buildings will be erected.

The Mills Machine Company, Lawrence, Mass., maker of paper, pulp and board machinery, is erecting new shops and is in the market for machine equipment of same.

The plant of the Doebler Manufacturing Company, hardware, of Middletown, Conn., has been sold to Colonel A. H. Pride, of New York. It will probably be operated for some purpose.

The James H. Williams Company, manufacturer of cotton and woolen mill supplies, Utica, N. Y., has let contracts for the erection of an addition to its manufacturing building.

C. A. Baird, of Eureka, Cal., representing the North Pacific Investment Company, has filed water rights on the falls of the Van Duzen River. His company will put up a power-house.

The Hewitt Manufacturing Company, journal bearings, Chicago, Ill., has had plans prepared for a foundry plant, with office and pattern shop. The plant complete will cost about $100,000.

The Pioneer Mill Company, Honolulu, Hawaii, will spend about $35,000 in the installation of an electric pumping plant for utilizing the water power at Lahaina. A pipe line will be built.

It is reported from the City of Mexico that G. F. Meehan, manager of the Monterey Iron & Steel Foundry, has gone to the United States to place the contract for equipment, amounting to $200,000.

W. S. Nott & Co., manufacturers of leather belting, etc., Minneapolis, Minn., are building a $20,000 factory. The building will be 50x 400 feet and will be used in the manufacture of "fire steamers" and supplies.

The construction of the Louisville & Atlantic Railroad shops, which will be permanently located at Richmond, Ky., has been commenced. About $50,000 will be expended in building and equipping the plant.

The Vulcan Crucible Company, of Pittsburgh, is arranging to enlarge its plant at Aliquippa. Eight puddling furnaces are to be added along with plate mills, annealing furnaces and other improvements.

The Republic Iron & Steel Company will add a gas producer plant to its mill at Alexandria, Ind., when the local capacity of the concern will be increased to twice its present size. The plant now employs 450 men.

The D. E. Whiton Machine Company, of New London, Conn., manufacturer of chucks, etc., has purchased two areas of land adjacent to its present quarters, and later it may utilize the new tract for a foundry.

Prescott, Ariz., has arranged to pump Del Rio water from the pipe line at the north end of the town pumping station, by electricity. Experts have figured that a dynamo and the necessary machinery would cost $20,000.

M. H. Treadwell & Co., Inc., engineers, founders, machinists and builders of special machinery, have opened an engineering and selling office at 307 Fourth avenue, Pittsburgh, Pa., same being in charge of L. L. Knox.

An election held at Kenton, O., to issue $50,000 park bonds to be used for retaining the Champion Iron Company, manufacturer of architectural iron work, recently burned, was carried, and the works will be rebuilt.

The New York State Land Board has made a grant of 11 acres of land under water to the Townsend & Downey Shipbuilding Company, Shooter's Island, which desires to extend its docks and piers and enlarge its plant.

A certificate has been filed in New Jersey consolidating the Steel Tired Wheel Company and the Railway Steel Spring Company under the title of the latter company and increasing the capital stock from $20,000,000 to $27,000,000.

Reed & Prince Manufacturing Company, makers of wood and machine screws, bolts and rivets, Worcester, Mass., has bought a tract of land at a different part of the city, where it is believed the company intends removing its business.

The Howery Manufacturing Company will build a plant in Chester, Pa., having bought six acres of ground. The company has been capitalized at $200,000. Heavy machinery and marine castings will be made and 250 men will be employed.

A new brick plant will be erected at Lock Haven, Pa. It will be known as the Lock Haven Paving & Building Brick Company. Ex-Sheriff Lewis Hoover has been elected president of the company, and S. D. Furst, secretary and treasurer.

The Knox Automobile Company, Springfield, Mass., is increasing its plant to raise its capacity from eight to twelve complete automobiles a week. The company has recently purchased improved machinery to the value of over $10,000, which will be installed.

The increasing business of the Springfield Facing Company, foundry facings and supplies, has made necessary the installation of a new boiler at its plant at Willimansett, Mass. It is likely that the business will demand the building of an addition in the near future.

It is reported from Oroville, Cal., that the Bay Counties Power Company has begun clearing ground for a large dam to be built near Nimshew at the head of the pipe line to the new power plant to be built on Butte Creek. It is expected to develop 12,000 horse-power.

Arrangements are on foot for the establishment of a $5,000,000 wire plant, in which fully 400 men will be employed. The location will either be Los Angeles, Cal., or San Francisco. Those chiefly interested are Henry E. Huntington, of Los Angeles, and D. O. Mills, of New York.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Patterns and models. 19 Thames st., N. Y.

We solicit inquiries for gear cutting. Benjamin Eastwood Co., Paterson, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Light machine & experimental work ; models made. S. Messerer, 15 Springf. av., Newark,N.J.

Fine and special machinery and experimental work guaranteed. Wyland Mfg. Co., Williamsport, Pa.

Small motor castings, wire and instructions, $1.00 ; model work done. American Art Agency, 127 Green st., Chicago.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings ; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

For Rent—A three-story brick building, 50x50 feet, with 15 H.-P. boiler and engine ; inducements given by Board of Trade. Geo. E. Babcock, Fort Plain, N. Y.

Purchaser for small manufacturing plant in Madison, Wis. ; lot, 100x180 feet ; machine shop, 32x68, two story, with line shaft and gasoline power ; foundry, 40x54, new modern equipment ; good location ; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Press work done at short notice ; blanking and drawing our specialty ; estimates cheerfully furnished ; tools for all work made on premises if desired ; copper, brass and nickel plating ; correspondence solicited. Acme Ball-Bearing Caster Co., Chappaqua, N. Y.

Engineers, Machinery Makers : Advertisers, having suitable premises now in course of erection, offer facilities for showing light machinery, motors, etc., in going order, on moderate terms of commission ; rent in accordance with space and power required ; office accommodation could be provided. Address X. Y., care of Housekeeper, 26 Ivy Lane, London, E. C., England.

Factory for Sale.—The land and building of the Branford Lock Works are offered for sale, comprising six acres of land and about 90,000 sq. ft. of floor area, together with boilers, engines, pumps, heating apparatus and electric light system ; Branford is seven miles east of New Haven, Conn., on the N. Y., N. H. & H. R. R. For particulars address the owner, The Yale & Towne Mfg. Co., 9 Murray st., New York.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine ; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R. ; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery ; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Draftsman, mechanical, desires position. Box 588, AMERICAN MACHINIST.

Foreman molder wants a situation ; long experience. Box 569, AMER. MACHINIST.

Draftsman, electrical engineer ; 4 years' experience ; rapid and good designer. Box 596, AMERICAN MACHINIST.

Mechanical engineer wishes to represent manufacturers in office or road. Box 599, AMERICAN MACHINIST.

Draftsman, inspector or buyer; 10 years' business and technical experience; best references. Box 601, AMERICAN MACHINIST.

Mechanical engineer, chief draftsman, wishes executive position; general experience; age 30. Box 590, AMERICAN MACHINIST.

Situation wanted, technical mechanic, 37; 8 years in charge of factory; correspondence solicited. Box 572, AMERICAN MACHINIST.

Draftsman, 25, German, technical graduate, experienced in dies, jigs and tool work, wants position. Box 589, AMERICAN MACHINIST.

Wanted—By 1901 graduate mechanical engineer, position with mechanical engineer or engineering firm. Address Box 579, AM. M.

Position wanted by technical graduate with 1 year's shop experience and 2½ years' drafting-room experience. Box 593, AMER. MACH.

Wanted—By young machinist, position with machinery firm, in office or as salesman; satisfactory references. Address Box 580, AMERICAN MACHINIST.

Draftsman, with technical and practical training on experimental work, wants position where results in some degree regulate the pay. Box 595, AMERICAN MACHINIST.

Tool designer wants position; expert at designing tools, jigs, fixtures, etc., for reducing the cost of manufactured articles. Wm. H. Flood, 308 W. 123d st., New York City.

By man, 35, superintendent or master mechanic, or to take charge of an experiment requiring deep study; reference present concern. Box 517, AMERICAN MACHINIST.

First-class man on tools and gages, including screw gages, desiring to change, would accept good position at highest wages; references. Box 591, AMERICAN MACHINIST.

Young man, 22, desires position in drawing room; has had practical experience in engine works; graduate of mechanical drawing school; best of references. Box 598, AM. M.

Mechanical engineer, graduate Stevens, several years' experience both mechanical and civil engineering, held important positions in Mexico, wants to change. Address Box 534, AMERICAN MACHINIST.

Machine shop foreman, of good executive ability, desires position; at present general foreman of tool works, with 7 years' experience on steam engine work; references. Box 581, AMERICAN MACHINIST.

Draftsman and designer, capable of engineering and superintending, large experience on automatic machinery and tools, age 31, graduate, references, wants to change. Box 600, AMERICAN MACHINIST.

Mechanical engineer, German, 26 years old, technical graduate, desires position; 5 years' experience designing cranes and all kinds of tools and tool machinery; good character; best references. Address L. E., care AM. M.

An American, just returned from Europe, where he has been for the past 6 years, laying down plant and superintending the manufacture of a specialty, wishes position as superintendent with reliable concern. Box 585, AMERICAN MACHINIST.

Experienced mechanical draftsman, technical graduate from Royal "Technicum Mittweida," wishes position; understands Spanish, French and German languages; salary expected, $15 per week for start. Address Arnold Hanel, 85 East 2d st., New York, N. Y.

A widely experienced superintendent and manager of machine works, expert in best shop practice and construction, of reliable executive ability and high-class references, seeks position with progressive and broad-minded concern. Address Y., 635 W. 61st st., Chicago.

Wanted—Outdoor work by mechanical draftsman, with 6 years' shop and 6 years' drafting-room experience on metal working, textile special, automatic, screw machinery, mill design, electric instruments, special tools; American, 32; M. I. T.; state particulars as to work and salary. Box 566, A. M.

An energetic and thoroughly competent mechanic, with extensive experience as designer and manufacturer of high-grade machinery of great variety, desires position as superintendent; thoroughly understands factory accounts, labor-saving machinery and economical production; excellent testimonials. Address Box 592, AMERICAN MACHINIST.

A man of experience with marine, locomotive and stationary engines and boilers, the erection of mining, milling and road-making machinery and plants (well up on foundations), desires a position as operating or erecting engineer, or at shop floor work; a permanent position the object in view. Address "R.," care AMERICAN MACHINIST.

Mechanical engineer, technical graduate, chief draftsman and expert designer, desires change; 8 years' experience as assistant M. E., M. E. and chief draftsman, in shop management, power plant installation, power transmission and design of light, heavy and automatic machinery; best of references. Address M. E., care AMERICAN MACHINIST.

Help Wanted.

Wanted—First-class toolmaker for Ohio. Box 584, AMERICAN MACHINIST.

Wanted—Good toolmakers. Keystone Electric Company, Erie, Pa.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—Lathe and bench hands; prefer men who have worked on gasoline engines. Box 583, AMERICAN MACHINIST.

Wanted—First-class metal and wood pattern makers; state age, experience and wages expected. Box 563, AMERICAN MACHINIST.

Wanted—Competent salesman to handle established business, high-grade steam engines, on commission. Address "Eastern," care A. M.

Machinists, send for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—First-class draftsman on engine work; state experience, reference and salary expected. The Ball & Wood Co., Elizabeth, N. J.

Wanted—Competent draftsman; one experienced in textile work preferred; state age, references and salary expected. Box 594, AMERICAN MACHINIST.

Wanted—Brass finishers and lathe hands, experienced on valves and fittings. Address, giving all particulars and experience, Box 562, AMERICAN MACHINIST.

Wanted—First-class instrument maker on fine interchangeable work. Address, stating experience and pay expected, "New York," care AMERICAN MACHINIST.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Foreman in machine shop manufacturing paper-making machinery and general jobbing. Address, stating age, experience, with whom, and wages expected. Box 568, AM. MACH.

Wanted—Diemaker who can make dies for cutting thin sheet, steel, brass, copper and aluminum; permanent position for competent man. Oneida Community, Ltd., Sherrill, N. Y.

Wanted—Foreman for machine shop doing jobbing work, small and large; in replying give full particulars as to age, experience and whether now employed, and where. Answer Box 576, AMERICAN MACHINIST.

Wanted—Outside man to sell factory supplies; one who has had some experience laying out shafting and belting drives preferred; state age, experience and salary expected. Box 597, AMERICAN MACHINIST.

Wanted—A first-class mechanical draftsman; one familiar with light work, such as typewriter work; must be first-class man. Address, stating age, experience and salary expected, M. D., Box 587, AMER. MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—First-class bench lathe hand, experienced on small duplicate brass work; must be a hustler and willing to break in beginners; steady job for the right party; state experience and wages desired. Address G. M., care AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Wanted—A man to take charge of screw machine department, both hand and automatic; must be energetic, thoroughly competent and understand his business thoroughly. Address, stating age, experience and salary required, "Screw Machine," Box 586, AM. M.

Wanted—Foreman to take charge of shop in which fine trains of gearing for electrical instruments are made in large quantities, also fine tool work; must be first-class mechanic with experience in handling help. State experience and address your reply to "Foreman," P. O. Box 606, Newark, N. J.

Wanted—A good mechanical draftsman for designing dies, tools and attachments to be used on presses and machines for working sheet metal; also experienced machinist to take charge of repair gang on general factory repair work; old, well-established and growing concern in central Connecticut; state age and experience in detail. Address Box 547, AMERICAN MACHINIST.

Draftsman wanted; experienced man who has done practical work in a modern plant and is familiar with up-to-date methods and devices for "doing things," who can design and make drawings for jigs and fixtures for manufacturing interchangeable work advantageously; state age, experience, wages expected, references. Address Leland & Faulconer Mfg. Co., Detroit, Mich.

Machinist Wanted.—To keep pace with our rapid growth we need an additional number of experienced machinists; we want steady men of good habits, looking for permanent positions; school, home and health advantages of Madison are unsurpassed; write immediately for particulars; state age, experience, etc. Northern Electrical Mfg. Co., Madison, Wis.

Wanted by a large manufacturing concern in Seattle, Washington, a first-class foreman blacksmith; a young, progressive man preferred; must have wide knowledge of all classes of blacksmith work, light and heavy, and above all he must be a good handler of men, familiar with drawings and of fair education. Address, stating full qualifications, reference and monthly salary expected, P. O. Box 319, Seattle, Washington.

Works manager required in the Manchester District for the manufacture of alternating and continuous current switchboards; must have had a large experience in the production of repetition articles, and be capable of laying out and organizing drawing office and works for the maximum output; good salary to first-class man. Apply by letter, stating experience, salary required, with testimonials and full particulars, to Ferranti, Limited, Hollinwood, Lancashire, England.

Works manager required in the Midlands (England) for the manufacture of large automatic engines; must be an experienced engineer of good standing and exceptional ability, and able to take complete charge of estimating, drawing office and works; must be thorough organizer, capable of obtaining maximum rate of output; to such a man liberal salary and first-class opening will be offered. Apply, stating age, experience, salary, references and full particulars, to Box 582, A. M.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co	62
Acme Machinery Co	18
Adams Co., The	82
Akron Electric Mfg. Co	68
Albro-Clem Elevator Co	62
Almond, T. R	77
Alteneder & Son, Theo	73
American Fdry. & Mch. Co	53
American Gas Furnace Co	15
American Roller Bearing Co	52
American School of Correspondence	16
American Tool Works Co	14
Aurora Tool Works	77
Armstrong Bros. Tool Co	60
Automatic Machine Co	62
Automobile & Cycle Parts Co.	51
Backus Water Motor Co	61
Baird & Co., Henry Carey	54
Baird Machinery Co., U	78
Baker Brothers	77
Baldwin, Davidson & Wight	64
Balkwill Pattern Works	82
Ball Bearing Co	18
Barker & Chard Mch. Tool Co.	79
Barnes Co., B. F	71
Barnes & Co., W. F. & John	14
Barnett Co., G. & H	4th Cover
Baush Machine Tool Co	65
Bay State Stamping Co., The	8
Beaman & Smith Co., The	8 and 66
Belmer Machine Tool Co	65
Bement, Miles & Co	2
Besly & Co., Chas. H	4th Cover
Bethlehem Fdry. & Mach. Co.	11

	PAGE
Betts Machine Co	5
Bickford Drill & Tool Co	12
Bienenstok & Co., E. A	58
Bilgram, Hugo	81
Billings & Spencer Co. 4th Cover	
Binsse Machine Co	18
Blaisdell & Co., P	58
Blanchard Mach. Co. 18 and	75
Bliss Co., E. W	58
Boker & Co., Herman	64
Boston Gear Works	15
Bowen Mfg. Co	8
Bowler & Co., Geo. H	73
Bradford Machine Tool Co	6
Bremer Machine & Tool Co	53
Bridgeport Chain Co	72
Bristol Co. 4th Cover	
Brown & Co., R. H	67
Brown & Sharpe Mfg. Co. 4th Cover	
Brown Hoisting Mch. Co	72
Buffalo Forge Co. 4th Cover	
Builders Iron Foundry. 3d Cover	
Bullard Machine Tool Co	16
Butler, A. G	16
Caldwell & Son Co., H. W	73
Carborundum Co., The	52
Card Mfg. Co., S. W	8
Carpenter Tap & Die Co., J. M.	8
C & C Electric Co	68
Central Foundry & Mach. Co.	54
Chadwick & Co., G. B	56
Chambersburg Engineering Co.	55
Champion Blower & Forge Co.	61
Charter Gas Engine Co	61
Chattanooga Machinery Co	11
Chicago House Wrecking Co	79
Chicago Pneumatic Tool Co	75
Chicago Raw Hide Co	17
Chicago Ship Building Co	79
Christensen Engineering Co	75
Church Mfg. Co	64
Cincinnati Mach. Tool Co	16
Cincinnati Milling Mach. Co	7
Cincinnati Planer Co	54
Cincinnati Shaper Co	18
Clark Auto. Telephone Switch Board Co	53
Clark, Jr., & Co., Jas	81
Clayton Air Compressor Wks.	75
Cleveland Crane & Car Co	72
Cleveland Gear Works	66
Cleveland Machine Screw Co	57
Cleveland Pneumatic Tool Co.	52
Cleveland Punch & Shear Wks. Co	86
Cleveland Twist Drill Co. 4th Cover	
Cleveland Wire Spring Co	61
Clough, R. M. 54 and	56
Coes Wrench Co	81
Colcord Mchry. Co., W. R	79
Columbus Machine Co	61
Commercial Electric Co	69
Consolidated Engine Stop Co.	71
Consolidated Schools	80
Cook Co., Asa S	66
Crane Co. 60 and	77
Cresson Co., Geo. V	81
Crocker-Wheeler Co	70
Crosby Stm. Gage & Valve Co.	15
Cullen, Orlan Clyde	64
Curtis & Curtis Co., The	62
Curtis & Co. Mfg. Co	73
Cushman Chuck Co	66
Dallett & Co., Thomas H	13
Dawson Mchry. Co., J. H	79
Detrick & Harvey Machine Co.	58
Diamond Drill & Machine Co.	55
Dickinson, Thos. L	64
Dixon Crucible Co., Joseph	56
Dreses Machine Tool Co	53
Dustin Co., Chas. E	78
Eastern Machinery Co	67
Elmes Engr. Works, Chas. F.	56
Emmert Mfg. Co	54
Errington Auto. Tap & Die Co.	67
Etna Mfg. Co	67
Evans Friction Cone Co	77
Excelsior Needle Co	15
Fairbanks Co., Philadelphia	79
Fairbanks Co., The, New York.	79
Fairbanks Machine Tool Co	73
Faneuil Watch Tool Co	86
Fawcus Machine Co	81
Fay & Scott	77
Fellows Gear Shaper Co	60
Ferodowill & Co., J. H	61
Flather & Co	16
Flower & Co., Walter L	74
Foos Gas Engine Co	61
Franklin Mfg. Co	60
Franklin Portable Crane & Hoist Co	72
Frick Co	61
Frothingham, N. L	64
Gang Co., Wm. E	55
Ganschow, Wm	56
Garvin Machine Co., The	17
Gates Co., Fred. P	67
Gay & Ward	59
General Elec. Co	69
Geometric Drill Co	66
German Niles Tool Works	85
Gisholt Machine Co	63
Gleason Tool Co. 4th Cover	
Gobeille Pattern Works	18
Gorton Machine Co., Geo	62
Gould & Eberhardt	18
Graham Mfg. Co	77
Grant Gear Works	18
Grant Mfg. & Mach. Co	18
Grant Tool Co	63
Gray-Blaisdell Co	74
Gray Co., G. A	18
Greaves, Klusman & Co	52
Greenwald Co., I. & E	82
Hammacher, Schlemmer & Co.	1
Hampden Corundum Wheel Co.	66
Harrington, Son & Co., Inc., Edw	70
Harris & Co., Sam'l	66
Hart Mfg. Co	80
Hendey Machine Co	51
Henley & Co., N. W	53
Hill, Clarke & Co. 13, 79 &	80
Hilles & Jones Co	54
Hill Tool Co	8
Hoefer Mfg. Co	8
Hoggson & Pettis Mfg. Co	67
Hollands Mfg. Co	66
Horsburgh & Scott. 4th Cover	
Horton & Son Co., E	66
Houghton & Co., E. F	57
Hunt Co., C. W	72
Hunt Co., Robt	61
Hurlbut-Rogers Machine Co.	11
Ingersoll Milling Mach. Co	60
Ingersoll-Sergeant Drill Co	75
International Corres. Schools.	80
International Steel & Mchry. Co	64
Iroquois Machine Co	63
Jacobson Machine & Mfg. Co. 67 and	83
Jantz & Leist Electric Co	68
Jeffrey Mfg. Co., The	79
Jenkins Brothers	60
Jones & Lamson Machine Co. 18 and	84
Kelly Machine Co., R. A	53
Kempsmith Mfg. Co. 52 and	79
Keuffel & Esser Co	80
Landis Tool Co	57
Le Blond Machine Tool Co., R. K. 59 and 4th Cover	
Le Count, Wm. G	66
Leland & Faulconer Mfg. Co.	54
Lieber Code Co	61
Link-Belt Engineering Co	73
Lodge & Shipley Mch. Tool Co.	4
Long & Allstatter Co	55
Lorentz & Evarts	82
Lunkenheimer Co., The	60
McCabe, J. J. 17 and	78
Machinery Exchange	68
McCrosky & Huber	77
Maris Bros	72
Marshall & Huschart Mch. Co.	79
Merrell Mfg. Co	60
Merritt & Co	77
Mich. College of Mines	16
Mietz, August	61
Millers Falls Co	53
Mitts & Merrill	67
Modern Tool Co	66
Morse Twist Drill & Mach. Co.	17
Morse, Williams & Co	54
Morton Mfg. Co	52
Mossberg & Granville Mfg. Co.	86
Mosse, Rudolf	80
Murdock Parlor Grate Co	53
New Britain Machine Co	58
New Era Iron Works Co	61
New Haven Mfg. Co	56
New Process Raw Hide Co	17
Newton Mach. Tool Wks., Inc.	11
N. Y. Gear Works	53
Nicholson & Co., W. H	75
Nicholson File Co	51
Niles Tool Works Co	78
Nolte Brass Co	55
Northampton Emery Wheel Co.	58
Northern Electric Mfg. Co	69
Northern Engineering Works.	72
Norton Emery Wheel Co	61
Nuttall Co., R. D	76
Nutter, Barnes & Co	15
Obermayer Co., The	70
Oesterlein Mach. Co	68
Olds Motor Works	61
Osborn Machinery Co	79
Parker Co., Chas	62
Patriache & Bell	64
Patterson, Gottfried & Hunter Co., Ltd	74
Pawling & Harnischfeger	72
Pearson Machine Co	58
Phoenix Mfg. Co	52
Phosphor Bronze Smelting Co.	64
Poole & Son Co., Robert	15
Potter & Johnston Co	10
Pratt & Whitney Co. 3, 76 and 3d Cover	
Pratt Chuck Co	66
Prentiss Tool & Supply Co	78
Purdue University	16
Quint, A. D	54
Rand Drill Co	75
Ransom Mfg. Co	82
Reed Co., F. E	55
Reeves Pulley Co	73
Regal Gas Engine Co	61
Rich, J. & G	64
Rivett Lock Co	86
Robbins & Myers Co., The	68
Rogers, Boat, Gage & Drill Works, John M	76
Roller Bearing & Equip. Co.	18
Safety Emery Wheel Co	55
Saunders' Sons, D	62
Sawyer, Ezra	61
Sawyer Tool Mfg. Co	76
Schumacher & Boye	9
Schwerdtle Stamp Co	67
Sebastian Lathe Co	58
Sellers & Co., Inc., William	18
Seneca Falls Mfg. Co. 52 and	67
Shepard Lathe Co	62
Shultz Belting Co	18
Sibley & Ware	64
Simonds Mfg. Co	13
Skinner Chuck Co	66
Slocomb & Co., J. T	62
Smith & Mills	52
Snyder, J. E	13
Sprague Electric Co	68
Springfield Gas Engine Co	61
Springfield Separator Co	73
Standard Connecting Rod Co.	60
Starrett Co., L. S	11
Steptoe & Co., John	18
Stowell, J. A	60
Struthers, Wells & Co	61
Stuart's Foundry & Mach. Co. 4th Cover	
Thompson, Hugh L	82
Toomey, Frank	79
Topping, Jas. R	54
Towsley Mfg. Co., J. T	55
Triumph Electric Co	68
Troy File Works	54
Trump Brothers Machine Co	66
Turley, H. G	55
Underwood & Co., H. B	62
Uniform Steel Co	10
U. S. Metallic Packing Co	53
U. S. Steel Co	64
Vanderbeek Tool Works	62
Vitrified Wheel Co	64
Waltham Watch Tool Co	72
Walworth Mfg. Co. 3d Cover	
Ward & Son, Edgar T	64
Warner & Swasey Co	58
Watson-Stillman Co	13
Weber Gas & Gasoline Eng. Co.	61
Westcott Chuck Co	66
Western Electric Co	68
West Haven Mfg. Co. 4th Cover	
Westmoreland Steel Co	64
Wheaton Machine Co	71
Whitcomb Mfg. Co	63
Whiting Foundry Equip. Co.	72
Whitney Mfg. Co	59
Whiton Machine Co., D. E	67
Wiley & Russell Mfg. Co	62
Williams & Co., J. H	81
Wilmarth & Morman Co	10
Windsor Machine Co	73
Winkley Co., The	75
Woodward & Powell Planer Co.	54
Worcester Mach. Screw Co	62
Worcester Polytechnic Institute	16
Wormer Machinery Co., C. C.	78
Wyman & Gordon. 4th Cover	
Yale & Towne Mfg. Co	72

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Ball Bearings

See Roller Bearings.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Blocks and Tackles

See Hoists, Hand.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry Co., Cleveland, O.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
Henley & Co., N. W., New York.

Boilers

Struthers, Wells & Co., Warren, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provl., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
See Grinding.

Castings, Iron
Church Mfg. Co., Adrian, Mich.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Motor
Ferodowill & Co., J. H., St. Paul, Minn.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.
U. S. Steel Co., Everett, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Ct.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Gates, Fred P., New London, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Codes
Lieber Code Co., New York.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Mchry Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. & Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Collars, Split
Central Fdry. & Mach. Co., Reading, Pa.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray & Blaisdell, Bradford, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelhia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
North Penn Iron Co., Phila., Pa.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.

Drawing Boards
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Phila., Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., B., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Radial
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Troy File Works, Troy, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Flower & Co., W. L., St. Louis, Mo.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Westmoreland Steel Co., Pittsburgh, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Turley, J. G., St. Louis, Mo.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Bienenstok & Co., Edgar A., St. Louis, Mo.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Bienenstok & Co., Edgar A., St. Louis, Mo.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F., & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Snepard Lathe Co., Cincinnati, O.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mach. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Frothingham, N. L., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cincinnati, O.
Machinery Exchange, Chicago, Ill.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.
Topping, Jas. R., Hartford, Conn.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mgf. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Elmes Engr. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Wks., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Elmes Engr. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cnadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua,

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
American Ball Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Wks., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby tSeam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
Purdue University, Lafayette, Ind.
Worcester Polytechnic Institute, Worcester, Mass.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Chicago House Wrecking Co., Chicago, Ill.
Colcord Mchry. Co., W. R., St. Louis, Mo.
Dawson, John H., Chicago, Ill.
Dustin Co., Chas. E., New York.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Osborn Mchry. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
Springfield Separator Co., Springfield, Vt.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New Haven.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Phila., Pa.
Dill Mach. Wks., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Herman Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Herman Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.
Westmoreland Steel Co., Pittsburgh, Pa.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trucks, Shop
Towsley Mfg. Co., John T., Cincinnati, O.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield Mass.
Barker & Chard M. T. Co., Cin., O
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Test of an Otto Gasoline Engine.

BY E. C. OLIVER.

The testing of gas or gasoline engines presents to the experimenter a number of difficulties not encountered in similar tests of steam engines or like motors. Especially is this so in that class of tests having in view a study of the heat distribution, as these tests necessarily entail measurements of the air supply and the losses of heat in friction and exhaust in addition to the ordinary determinations of power and fuel supply.

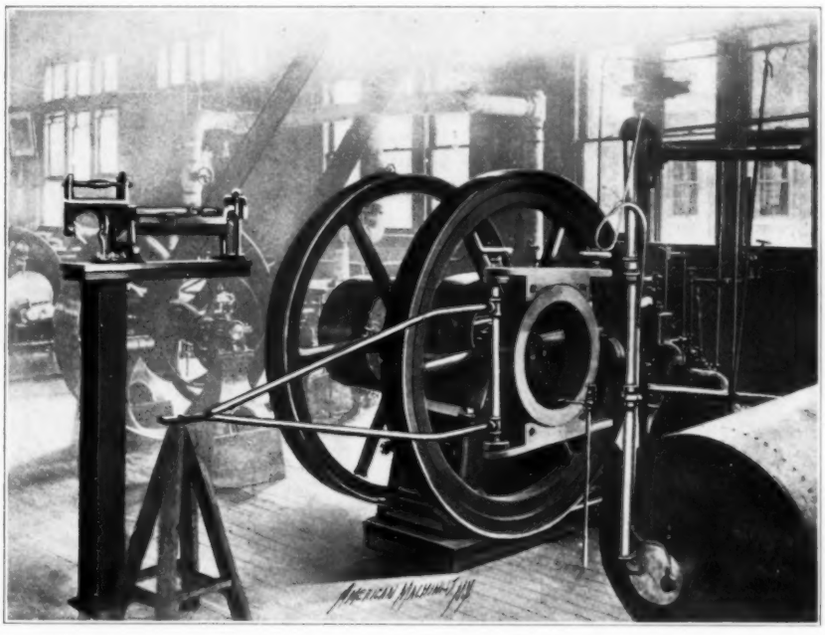


FIG. 1. GASOLINE ENGINE AS ARRANGED FOR TESTING.

There are a number of gas-engine trials on record in which an attempt has been made to account for all the heat supplied in the form of fuel, and such heat balances have been carried out in considerable detail, yet in each case, so far as the writer has been able to ascertain, these results have never been based on direct and absolute measurement, but have been computed from some important assumption, usually the temperature of the charge before compression, and consequently the accuracy of the results must depend on the accuracy of this assumption.

In the course of instruction in the mechanical laboratory of the University of Illinois the writer has carried out a number of trials of the above sort in which an attempt was made to eliminate as far as possible any inaccuracies due to these assumptions. Absolute measurements were made of all important quantities, necessitating the use of methods somewhat different from those ordinarily employed.

The object of these tests was to obtain as accurately as possible a heat account or heat balance for the engine and the temperatures within the cylinder at various points in the cycle.

There is supplied to a gas or gasoline engine at each cycle a definite amount of fuel and a definite amount of air, which, when combined and ignited, give out a definite amount of heat. After combustion this heat finds its way to one of the following ends: Useful work, friction in engine, jacket water, exhaust, and radiation. A correct heat balance would therefore have on its debit side the total possible heat supplied and on the credit side the amount of this heat delivered to each end.

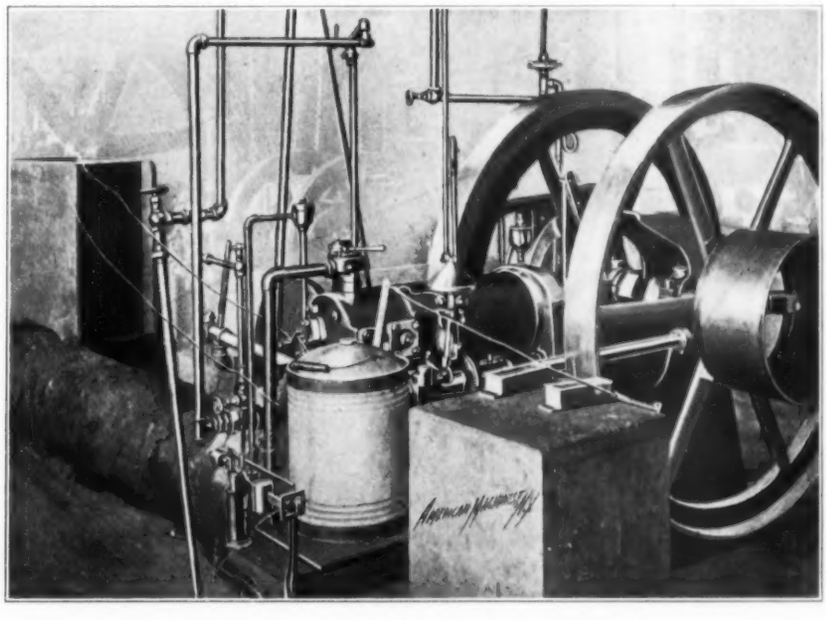


FIG. 2. GASOLINE ENGINE AS ARRANGED FOR TESTING.

The engine used was of the ordinary four-cycle type built by the Otto Gas Engine Works, of Philadelphia, Pa. The cylinder is 5¾ inches diameter by 12½ inches stroke, with 107 cubic inches clearance. Before the test all valves were ground in and all joints made perfectly tight. The engine and general arrangement of apparatus is shown in the halftones, Figs. 1, 2, 3, and the line engraving, Fig. 4.

The work done by the engine was absorbed by a prony brake having an effective length of arm of 62¼ inches (33 feet circumference). The arm rests on the platform of a scale accurate to .02 pound. The brake shoes were of wood acting against a cast-iron, water-cooled brake wheel.

The indicated horse-power was measured by means of two Crosby gas-engine indicators, in one of which was used a 240-pound spring and in the other a 60-pound spring. The former was used for the power diagrams and the latter was stopped off at about 100 pounds pressure and was of use in obtaining to a larger scale the exhaust, suction and compression strokes. The springs were carefully calibrated under steam pressure and gave their proper scales. The indicators were driven from the piston by means of a pendulum reducing motion. Sample indicator diagrams, full size, are shown in Fig. 5.

The heat absorbed by the jacket was measured by collecting the circulating water in a tank on scales and noting the rise in temperature by means of thermometers in the intake and overflow pipes. An even rate of flow was maintained by means of a constant level tank above the engine.

The heat rejected to exhaust was measured directly in a somewhat similar manner. The exhaust gas was passed through the steam space of a Wheeler surface condenser which was connected to the exhaust chamber of the engine as closely as possible and wrapped with hair felt. Water was circulated through the condenser from the constant level tank, caught, weighed, and the temperature rise noted, the same

as for the jacket water. In addition, thermometers were placed in the outgoing exhaust gas and the ingoing air to ascertain the amount of heat still remaining in the exhaust. This apparatus is most apparent in Fig. 3.

The weight of gasoline was obtained by supplying the engine from a tank resting on the platform of a scale. The gasoline flowed into a reservoir of small cross-section in which the level was kept constant. The weight used at any time may be known by balancing the scale.

The weight of air used was directly measured by means of a high-pressure storage tank of known volume, into which air was pumped by an air compressor. At various hights throughout the length of the tank inclined copper thermometer wells were inserted which contained thermometers for reading the temperature of the compressed air. From this tank the air was delivered through a reducing valve to a low-pressure tank in which a pressure of from ½ to 1 inch of water was carried and from which the engine could be made to take its supply. Two quick-opening valves being arranged in such a way that the air supply to the engine might be taken from the tank or from the room at will.

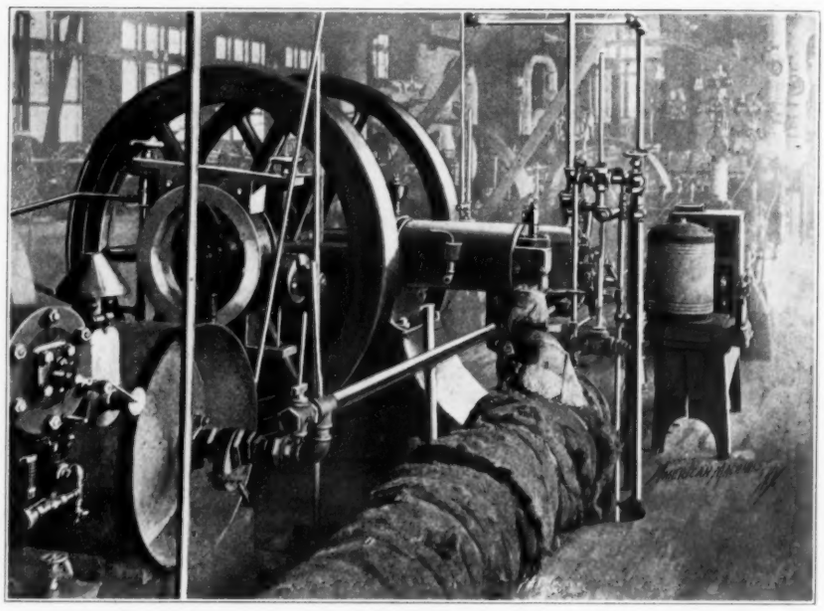


FIG. 3. GASOLINE ENGINE AS ARRANGED FOR TESTING.

In running a test the gas engine was started and kept in operation long enough to bring the conditions uniform. The air pressure in the tank was increased until it was slightly in excess of 100 pounds gage, when the valve in the discharge pipe was shut, thereby cutting off all connections to the tank except the one to the engine. At the moment the gage showed 100 pounds the temperature was taken and the valves changed so that the air came from the measured supply. The test was then continued as long as desired (within the capacity of the tank) and at the end the valves were reversed and the measured air cut off from the engine. The temperatures and pressure were again noted and the quantity of air in the large tank before and after the test was computed, the difference being the weight used.

Samples of the exhaust gas and gasoline were analyzed and the heating value and density obtained. The revolutions and explosions were recorded by means of square counters, the former being actuated from the side shaft of the engine and the reading being consequently one-half of the actual number of revolutions and the latter being driven from the gasoline injection valve gave the number of explosions. In these tests the governor was blocked so that an explosion occurred at each cycle and the readings of the counters would of course be identical, but were used for a check.

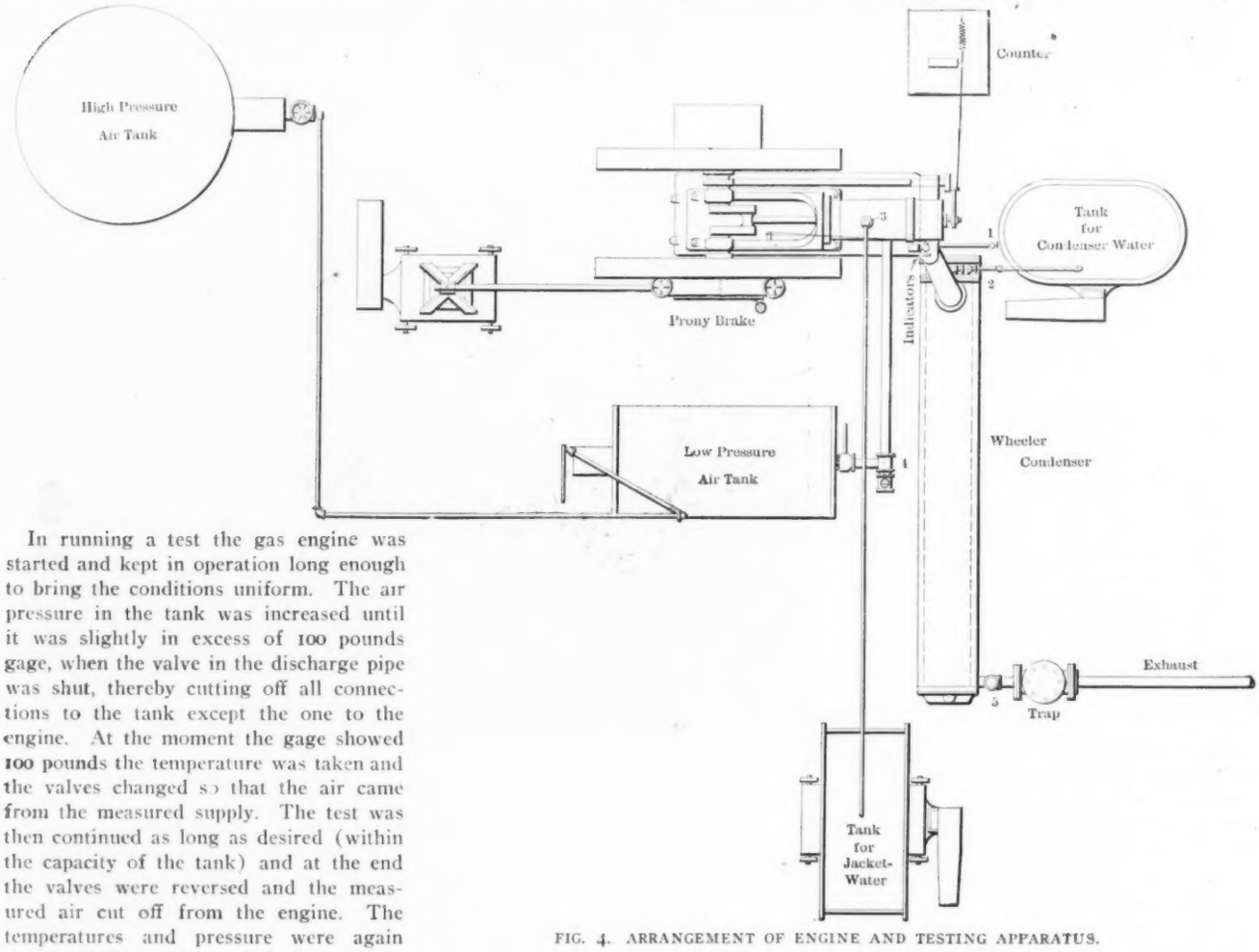


FIG. 4. ARRANGEMENT OF ENGINE AND TESTING APPARATUS.

All the instruments used—scales, gages, thermometers, etc.—were carefully calibrated by two sets of observers and corrections made where necessary.

The data obtained from one of the series of tests made are as follows:

Engine cylinder—5¾ inches diameter, 12½ inches stroke.

Clearance—107 cubic inches.

Duration of test—22¼ minutes.

Brake load—30 pounds.

Revolutions per minute—299.6.

Total number of explosions—3,332.

Weight of gasoline—2.43 pounds.

Jacket water weight—361 pounds.

Jacket water rise in temperature—47.4 degrees.

Brake horse-power—

$$= \frac{2\pi R W N}{33000} = \frac{33 \times 30 \times 299.6}{33000} = 8.988$$

Indicated horse-power—

$$= \frac{P L A N}{33000} \quad \frac{87.54 \times 12.5 \times 26 \times 1428}{12 \times 33000} = 10.75$$

Friction horse-power—

$$10.75 - 8.988 = 1.762.$$

Mechanical efficiency—

$$\frac{8.988}{10.750} = 83.61\%$$

Thermal equivalent of brake horse-power—

$$8.988 \times \frac{33000 \times 22.25}{778} = 8483 \text{ B. T. U.}$$

be found from the specific heats of the component gases by adding together the proportional parts as follows:

	% by wt.	Cp.	Cv.	% Cp.	% Cv.
CO_2	9.26	.2169	.172	.0197	.0156
O	3.38	.2175	.1551	.0073	.0052
H_2O	7.51	.480	.370	.0362	.0278
N	79.85	.2438	.1727	.194	.1866
				.2573	.1866

Then for the exhaust gas Cp = .2573, Cv = .1866 and R = (Cp—Cv) 778 = 55.

Returning now to the heat still remaining in the exhaust gas we find this amount as follows:

$H = 45.1\ (102 - 70)\ .2573 = 371$ B. T. U.

We now have all the heat accounted for except radiation, and we may make the entries in the heat balance thus:

	Dr.	Cr.
	B.T.U.	B.T.U.
2.43 lb gas'line @ 18281 B.T.U	44423	
9.988 B.H.P for 22¼ minutes		8483
1.762 F.H.P. 22¼ minutes		1663
361 lb Jacket water @ 47.4°		17111
382 lb exhaust cool. water @ 37° = 14134		
Heat remaining in exhaust, 371		
Total heat rejected to exhst.		14505
		41762
Radiation and other loses		2661
	44423	44423

Stated in percentages this heat balance will appear as follows:

Heat supplied, 100 per cent.

Brake horse-power	19.1
Friction horse-power	3.7
Jacket water	38.5
Exhaust	32.7
Radiation	6.
	100.0

The thermal efficiency of the engine will be the sum of the first and second entries or the heat equivalent of the indicated horse-power divided by the total heat supplied.

19.1 + 3.7 = 22.8 per cent. thermal efficiency.

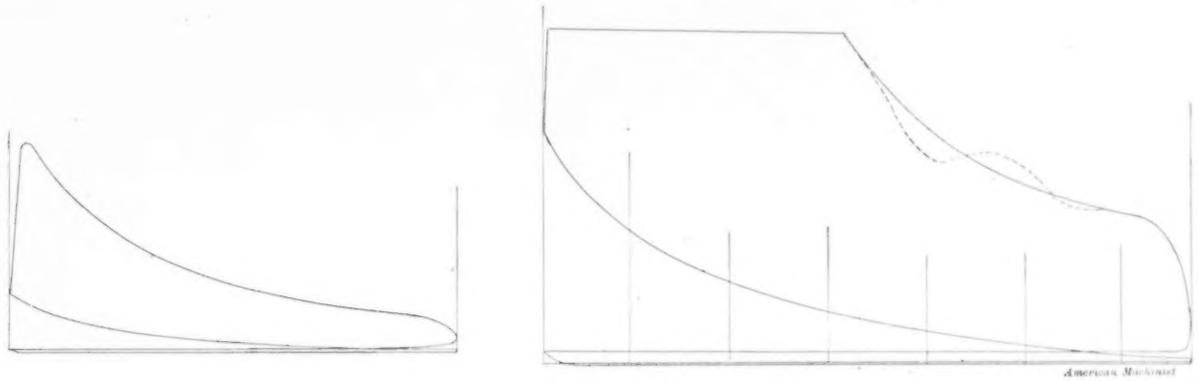


FIG. 5. SAMPLE INDICATOR DIAGRAMS.

Exhaust cooling water—382 pounds.

Exhaust cooling water rise in temperature—37 degrees.

Air pressure in tank at start—10 pounds gage.

Air pressure in tank at stop—1 pound gage.

Air temperature in tank at start—96.8 degrees.

Air temperature in tank at stop—78.8 degrees.

Temperature of air entering engine—70 degrees.

Temperature of exhaust gas leaving cooler—102 degrees.

Scale of spring in power indicator—240.

Scale of spring in pumping indicator—60.

Gasoline analysis—

Carbon	.838
Hydrogen	155
Impurities	.007
	1.000

Heating value per pound—18,281 British thermal units.

Density—71 degrees Baumé.

Burned gas analysis—

	By weight.
CO_2	.0926
O	.0338
H_2O	.0751
N	.7985
CO	.0000
	1.0000

Thermal equivalent of friction horse-power—

$$1.762 \times \frac{33000 \times 22.25}{778} = 1663 \text{ B. T. U.}$$

Heat taken up by jacket water—

$361 \times 47.4 = 17111.4$ B. T. U.

Heat taken up by exhaust cooling water—

$382 \times 37 = 14134$. B. T. U.

To ascertain the amount of heat still remaining in the exhaust gas it is necessary to know the weight of this gas and its specific heat.

The weight of air in the storage tank before and after the test was obtained by the use of the fundamental thermo-dynamic formula $P V = m R T$, in which

P = the absolute pressure per square foot of the gas,

V = the volume of the gas,

m = the weight of gas in pounds,

R = a constant depending on the character of the gas. For air it is 53.38.

T = the temperature in degrees absolute = F° + 461. This formula may be written: $m = \frac{P V}{R T}$

Then before the test

$$m = \frac{1147 \times 144 \times 89.6}{53.35 \times 557.5} = 49.74 \text{ pounds.}$$

After the test

$$m = \frac{15.7 \times 144 \times 89.6}{53.35 \times 537.2} = 7.07 \text{ pounds.}$$

Air used during test = 49.74 — 7.07 = 42.67 pounds. 42.67 + 2.43 (gasoline) = 45.1 pounds = total weight of exhaust.

The specific heat of the exhaust gas may

A "Follow-Die" Which Draws, Pierces, End-Finishes, Cuts Off and Bends in One Operation.

BY JOSEPH V. WOODWORTH.

The "Follow Die" here shown was used in one of the largest sheet-metal goods establishments in New York for producing parts of sheet tin of the shape shown in the three views up at the left of Fig. 1.

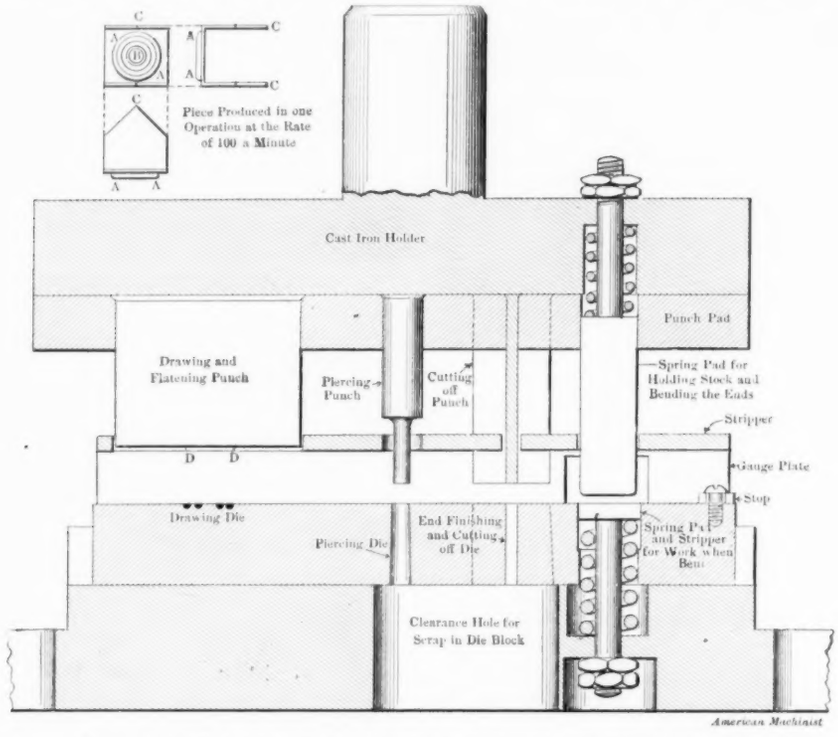


FIG. 1. "FOLLOW DIE" COMPLETE FOR DRAWING, PIERCING, TRIMMING AND BENDING IN ONE OPERATION.

These pieces are required in large quantities, and are used for fastening the corners of thin wooden boxes, such as grape crates, baskets, small packing boxes, and so on. As the number of these tin fasteners required during the past season exceeded twenty millions, the necessity for producing them as rapidly and as cheaply as possible is at once obvious. I may say before describing the die that the shop in which it was made and used makes a specialty of sheet-metal articles for which the demand is enormous, and that their chief concern is to produce these articles as cheaply as possible. Expense in the constructing of a die means very little to them, if it will reduce the number of operations in the production of the part required. In this establishment dies of every type imaginable have been improved in every manner possible, so that sheet metal articles, which in numbers of other shops would require two or more operations to produce, are here produced in a single operation. The types of dies which have been improved the most, and from which the best results have been secured, are of the "Gang" and "Follow" types, numbers of which work upon a strip of stock from five to eight times before the finished piece drops off the die.

To produce the fasteners as shown, it is necessary to draw two rings at *A A*, pierce the central hole *B*, finish the ends *C C* to angles of 45 degrees, cut off the blank and then bend it to the shape shown. In Fig. 1 the manner in which these separate workings of the metal follow each other can be clearly seen. The punch, or male die, consists of the usual cast-iron holder, and the machine-steel pad in which the punches are located and secured. The first punch is that which draws the two rings *A A* and at the same time flattens the stock; the second is the piercing punch which pierces the hole *B;* the third punch is the end-finishing and cutting-off punch, while the last acts in the double capacity of spring pad and bending punch. The construction and relative positions of the punches require no description.

The die is in one piece, made in the usual manner, except for the bending die, which consists of a square milled channel across the face to the depth shown, and which is equipped with a spring pad for holding the metal while it is being cut off by the end-finishing punch, and for stripping the finished work from the die as the punch rises. As shown in the plan of the die, Fig. 3, the gage plate is located by two dowel pins, and has a clearance channel let through it in line with the bending die as an exit for the finished work, which, as the press is inclined, drops out at the back as soon as it is stripped from the die. As shown, the die is equipped with two tension buttons which keep the strip of stock against the gage plate and in line with the different dies. When in use the punch and die are in the relative positions shown in Fig. 1. The drawing and flattening punch is the shortest, this being necessary to allow the other punches to do their work.

The metal is fed by an automatic roll feed. At the first stroke of the press the two rings *A A* are drawn and the stock is flattened; at the next the hole *B* is pierced and one of the ends *C* trimmed; at the third stroke the bending punch, acting as a spring pad, holds the metal while the other end is being finished and the piece cut off, the punch continuing to descend until the bending punch strikes the face of the holder when the metal is bent into the bending die. As the punch rises, the bending punch is forced outward by the spring at the back and the finished work is stripped from the die by the spring pad. This die produced 75,000 of the pieces shown in a working day of ten hours.

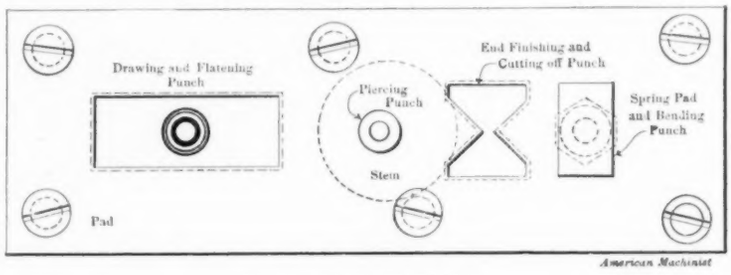


FIG. 2. PLAN OF PUNCH.

Echoes From the Oil Country.

BORING CYLINDERS TAPER.

When Mr. Tecumseh Swift calls attention to the limitations of peening he makes a point that can well be applied to all work on metal, and that point is found in the truth that all metals are filled with strains of various kinds, and that every operation that is performed will be likely to alter these to an extent that may result in a change of form of the piece operated on. While in r any cases the change is not great enough to cause trouble, that does not indicate that no change has taken place. The poor mechanic or man accustomed only to rough work may imagine his output is perfect, but the top-notcher knows better.

After the most careful annealing, a piece of steel will crawl a little on having a cut removed; and the most careful handling will do a little springing or changing of shape on most work that has to be held to-

work on. No doubt a great many really good men will be ready to take issue with me on this, but that doesn't matter, as the best ones will agree with me.

When I was an apprentice a fellow workman tried to sell me a watch. I didn't know much about watches, except that they were machines that moved with a somewhat regular motion, and that a large part of their value lay in their ability to have this motion really a regular motion, so I asked him how close the watch would run. "It runs right up to the dot," he replied. "For how long?" I asked. "For any length of time, if you keep it wound," I was told. "What clock do you test it with?" said I. "Any clock at all; it will run with any of them," said he. I suggested trying it with the shop clock, which we all thought a good one. It lost five minutes over night and five more before noon, and I began to see that some people's standards of accuracy were like the fine machinist's "scant 1-64 inch,"

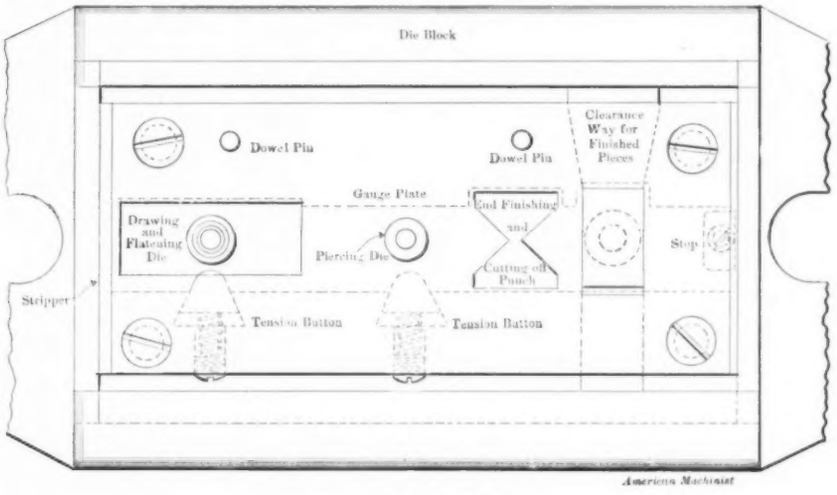


FIG. 3. PLAN OF DIE.

which some still believe in and swear by. I didn't buy the watch, but I never yet owned one as good as that one was said to be. I would be afraid to buy one that didn't vary at all; one or two seconds off every once in a while would be close enough for me.

Some men seem to have a natural sense of what a piece will do under certain treatment, and they plan things so that their results are good, while others take elaborate precautions and get poor results.

I once worked near a new milling machine on which a man was planing some pieces about 2½ inches square by 10 inches long. They were held down by clamps on each end. The clamp was just a bolt in the table slot and a strap with a tit on one end going into a hole in the end of the piece to be planed, a nut on the table took the outer end of the strap. This was the first and only milling machine in the shop, and it was just being put to work—and such work as it did turn out! full of chatters and the pieces not even parallel. That machine was criticised pretty harshly until it was suggested that a little more brains and less muscle *might* keep the bolts from curling up the table and give things a chance.

Occasionally some paper starts a discussion as to the proper way to use a monkey-wrench. I would say to use it as gently as you can, and be lazy enough to quit pulling as soon as you dare to if you are holding work on a machine. The ammonia cylinder we had to bore out needed to be as smooth and round as we knew how to make it, and the 32-inch lathe was new and good and we set out to do our best. The regular rig would not go on this lathe and the cylinder was too big for the lathe it would go on, so we had to block it up as best we could. In setting and trying first one end and then the other it was found that something was moving, and after quite a hint it was found that a large man with a 16-inch wrench could spring a lathe carriage so that it about rested on two points and that the way to hold things properly was to let a little lazy fellow with a 12-inch wrench do the tightening. This is only one of the ways that bad work is done and blamed on the machines.

I once had the pleasure of bossing a night gang on engine work and gave one man a lot of piston heads to turn up. He presently informed me that the cylinders were all taper—not much, "just a feel," but that feel hurt me. That might do for the day gang—we would do it differently; too much clearance on the finishing tools, no doubt, so I cautioned my man to be careful. Still they came taper. I was busy getting the work all running smoothly and only investigated enough to find out that those bored for some time before were all taper a little but had not given trouble, so I waited a little before finding time to trace the matter down.

In the meantime I began inquiries as to what causes could make a cylinder taper in boring. I learned lots and lots about boring cylinders and ways of boring them that I had never dreamed of, the only trouble was they didn't fit my case. In our rig a lathe was used. For a bar we had a steel shaft about 5 inches in diameter and somewhat longer than twice the length of the cylinders. One end had a good big center in it, while the other one was a taper fit in a flange that centered on the face-plate and was bolted securely. The cutting was done with a single-pointed tool, one for roughing and another for finishing. The tool was held in a slot in the bar by a key. The cylinders were held with two clamping devices that bolted to the carriage and somewhat resembled huge steady rests. Extra strong gibs were added to keep the carriage from lifting. The steam chest and exhaust flange were in such shape that the cylinders could only be put on one way.

I don't wonder you don't see anything strange about getting a hole a few thousandths tapering with such a rig and making one tool do all the cutting on a 10-inch cylinder 19 inches long; neither did I until I found that they were all large at the end the tool cut last. It took me a good bit to convince myself of this and some more of a bit to convince others, but so it was—not a bit of doubt about it. Those holes were not being sprung either, as from the form of the cylinder they needed to be held only tight enough to keep from lifting. They could neither turn nor push endways, and I can answer for some of them being bored with a very light hold. Investigation showed that the hard cylinders were worse than the soft ones and those bored where things were rushed were worse than those done slower.

The average time taken to set, bore and counterbore and take off was about two hours each, five being done in a night of twelve hours, the rig being put on and taken off and the machine cleaned up.

I blamed it at last on heat—expansion and contraction of the cylinder during the finishing cut and expansion of the tool. To test my conclusions I tried letting a cylinder stand for an hour and then running the finishing cut at about half the usual speed. This gave a cylinder that with calipers appeared straight.

As there was not a micrometer in the shop I could not tell the exact taper we usually got, but I have since figured that a difference of 10 degrees in the ends of the cylinder and a rise in temperature of 20 degrees in the tool during the finishing cut would make a taper of more than .006 inch, which was more than the actual variation. This may or may not be the correct reason. I am positive of the fact of the taper.

I have seen it stated that a certain engine made in England has cylinders true to standard to within .0005 inch. I have wondered whether the decimal point was in the right place or not. If it is, I would like to know how this result is obtained, and at what rate and cost. Not many concerns making cylinders would care to guarantee them all the same size to within

one-half of a thousandth, while in the case referred to that error and the variations in size combined must not exceed that. If this is indeed strictly adhered to, I would like to take a stroll around their scrap pile and keep check on it for a time.

Few people who have not had to make it a study realize how easily large, strong pieces can be slightly sprung or what an important part heat plays in the cost where extreme accuracy is aimed at. Anyone having a 6-inch micrometer on hand can readily make a practical test to illustrate the effect of a little heat by setting it open to a large size and so that a bit of wire or pin gage or an inside micrometer will be held between the points with just sufficient force to hold its weight. Have the outside of the micrometer held upright in a block and let the piece hang between the points long enough to make sure it is secure, then place the hand gently on the micrometer on the inside and note how quickly the piece will drop and how the feel is gone.

This tried a few times is likely to bring a feeling of respect for the attainments of the really fine workmen who cut thousandths, and some even tens of thousandths, into numerous pieces, and then feel dissatisfied just as we do about our work.

I examined a cylinder of a new steam engine one day. The tool marks were not worn out anywhere, yet it measured more than 1-32 inch out of round, and that machine didn't bore elliptical either, as far as the tool was concerned.

Come to think of it, it's rather hard to tell how one knows when to stop pulling in tightening up. Of course I broke quite a number of bolts, intentionally and unintentionally, learning what I know of it, and others have done the same. I think if I were to try to tighten up a ½-inch bolt in the dark where it needed to be as tight as was safe, thinking it was ¾, I would be sure to twist it off; and even after years of experience in tightening things, I dislike to tighten a ¼-inch nut with a 16-inch monkey-wrench.

Mr. Tecumseh Swift seems to reflect somewhat on the advisability of peening a fair sized shaft straight with a hand hammer. It all depends. Since reading his criticism I have had a talk with the man for whom I straightened the engine shaft. This, you will recollect, is a cast-iron shaft with disk on one end. He says it is over seven years since the job was done, and he has never been able to find any signs of its being out of true. He said he had examined it carefully a short time ago when he was telling a friend of its having been straightened in that manner.

I have straightened a 6-inch cast-iron boring bar that has held up well for several years and the hammer proved heavy enough. I have been where I could watch the bar. While I have seen some work of this kind done with a sledge, I never used one, as 6 inches diameter is the largest I have ever had to work on. Where a piece is thin, say 1½ inches or less, a hand hammer will have sufficient penetration. Perhaps the word "tap" has misled my friend as to the force of the blows; so I would say hit just hard enough. If it is a 3-inch cold-rolled shaft you are at a blow about one-third of what a skilled man can strike when doing heavy hammering will be hard enough, and the peen of the hammer should be of such shape that this would not make a spot more than ¼ inch in diameter. It is not a wide but a deep spot that does the work that stays. The shape of the hammer being right, the job will be more lasting than if done with a sledge on moderate sized pieces.

If any of Brown & Sharpe's men read this I don't think they will try peening their face plates or milling machine tables, but the fellow that gets caught out in the woods or in a little job shop that stands ready to help all creation need not hesitate to use it, just as he does a whole lot of other abominable things that help him to get mechanical results by unmechanical methods.

W. OSBORNE.

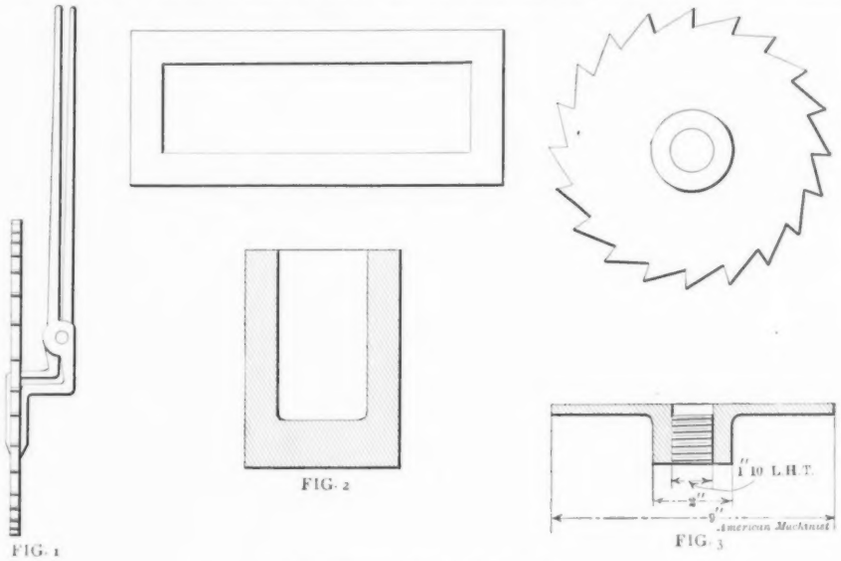


FIG. 1 FIG. 2 FIG. 3

HARDENING THIN CUTTERS.

Hardening Thin Cutters.

BY E. R. MARKHAM.

Probably the idea of hardening thin cutters between plates whose surfaces are smeared with oil is familiar to all readers of the AMERICAN MACHINIST; but a few hints as to methods of heating and arrangement of plates for cooling the work, when done in quantities large enough to warrant the necessary expense of rigging up, may not be amiss.

In the first place, the stock should be pickled to remove the scale. This is necessary if the sides of the cutter are to be machined, as the scale would dull the tools, and it is necessary if sheet steel is used of the required thickness, as the scale would rise in the form of blisters and prevent the steel directly under them from hardening properly.

When heating to harden, the fire should *not* come in contact with the cutters. If we have a muffle hardening furnace, the cutters should be heated in the muffle on a plate whose upper surface is perfectly flat, as the cutters will conform in shape to the surface they are lying on when red hot. It is advisable, for the sake of economy, that the plate be large enough for quite a number of cutters to be heated at once. As one cutter is taken out, another may be put in its place. A pair of tongs of the form shown in Fig. 1 should be used, as with these the cutter may be grasped by the portion next to the hole, thus avoiding chilling the teeth, as must be the result where a pair of the ordinary form is used.

If a muffle furnace is not to be had, almost any fire may be used by making an oven—if I may so term it—as shown in Fig. 2. This should be blocked up with a couple of pieces of brick or iron, so that the fire may be poked under it as it burns out. The fire should be under and on top and at the back of the oven to insure enough heat to properly heat the cutters, which are to be placed inside.

After bringing the cutter to the proper heat for hardening—which depends somewhat on the make of steel—it should be grasped by the tongs as shown in Fig. 1 and placed on the bottom plate; then the top plate should be placed on the cutter as quickly as possible and held there until the cutter is cold. The surfaces of the plates facing each other should be smeared with oil.

When two ordinary flat plates are used it requires the services of two persons to properly do the work, one to handle the work with the tongs, and one to handle the plate. If the work is to be done in large batches it is advisable to make such arrangements that one man may accomplish both operations. This can be done by placing the lower plate in a pan of oil—sperm or raw linseed oil will do. The oil

should not come above the top surface of the plate and should be smeared on the plates with a brush each time a cutter is to be hardened. The upper plate should be quite heavy and either have two holes through it to act as guides through which pieces of round stock may pass, these pieces stationary with the lower plate, or there should be some form of way planed in the two opposite ends by means of which it could slide on suitable rails, making the action similar to that of a small hand drop. A pulley should be attached to the ceiling overhead and a piece of rope or belt attached to the upper plate passing over the pulley and down to the operator. This simple equipment may be elaborated to any extent if the outlay is warranted by the quantity of work to be done. A machine having an upper and a lower plate, made hollow and connected with a supply of water which should be kept circulating through the plates when in use, the upper plate attached to an arm operated by a treadle by means of which it may be raised and lowered, will be found to give excellent results. When using either of the above mentioned devices the lower plate may be arranged to sink into the pan of oil when the top plate is resting on it, so that the lower plate and the work will be entirely submerged in the oil, in which case the oil coming up part way on the top plate will do away with the necessity of smearing the surfaces of the plates each time.

Thin cutters of the kind under consideration are difficult to brighten to draw the temper by color, as they are liable to warp out of shape during the operation. Then, again, it is a costly way of doing if there are many cutters to be tempered. Much more satisfactory results will be obtained if the temper is drawn in a kettle of oil, using a thermometer to gage the heat. The degree of heat to which they should be drawn depends on the grade and make of steel, the heat given them when hardening, the thickness of the cutter and the use they are to be put to. Metal slitting saws for general jobbing purposes should be drawn to 460 degrees. If they are to be used on ordinary power milling machine work for the general shop product, unless the stock to be cut is tool steel, 500 degrees will generally be found satisfactory. For screw slotting saws .060 inch thick and under, 525 degrees; if thicker, do not draw as low. These temperatures given for temper are not intended as a rule that must be arbitrarily followed, but should be changed to adapt the hardness of the tool to the stock operated on and to the conditions under which they must be used.

When I was connected with a concern manufacturing bicycles, it was necessary at one time to make a saw 9 inches diameter and ⅛ inch thick. This saw was to be attached to a shank at its extreme end, as it operated close to a shoulder; the shank of course fitted the hole in the spindle of a milling machine. Fig. 3 gives an idea of the saw. Our grinders were busy all the time, and in fact were running overtime, so it was desirable to harden this saw in a manner that would avoid its springing. We packed it in a hardening box in a mixture of equal parts of granulated charred leather and granulated charcoal, put it in the hardening furnace, and by means of the test wires described in a former article, found out the exact time when the box was heated through, ran the work 1½ hours after it was red hot, then took the box from the oven and allowed it to cool. The saw was then taken from the box and heated in a muffle furnace until it was at a *low* red heat. It was then placed on a plate in a pan of oil, the upper plate, in the center of which a hole had been bored somewhat larger than the hub of the saw, was placed on it and a quantity of oil was poured in the pan. This extra oil, which was kept agitated with a paddle, worked between the plates, thereby assuring the hardening of the teeth. As this cutter was intended to cut clincher tubing it was only drawn to 400 degrees when tempering. It ran nearly dead true when put on the arbor. We afterwards had occasion to make several of these cutters, and had equally good success in hardening them.

The object in giving the second heat was to close the grain, making it more compact than if hardened from the charging heat. I considered this advisable on account of the condition of the stock it was to cut. Clincher tubing is made of sheet steel, having its edges punched saw-tooth shape; it is then folded round and the edges are brazed. Although strong it is pretty tough on cutting tools.

As no considerable quantity of oil came in contact with the hub, it was left soft, thereby avoiding any tendency of cracking from uneven contraction.

Trade Matters in Tangiers, Morocco, and in Gibraltar.

[From our Special Correspondent.]

Editor American Machinist:

After a rather rough trip across the Atlantic, I arrived on the 11th inst. at Gibraltar. There I took the first boat to Tangiers, on the 13th. The passage across the Straits takes only 4½ hours. The boats, however, are very small and uncomfortable; I think a New York ferryboat could make the trip from Gibraltar to Tangiers in less than 2 hours.

Morocco has no industries whatever. The exports consist mainly of eggs, coffee, Moorish slippers, goat skins, wax, carpets, and dates. The imports in which the readers of the AMERICAN MACHINIST may be interested include hardware, iron and steel. In 1901 the imports of these articles into Tangiers were as follows: Hardware, $41,210; iron and steel, $29,820.

There is a slight demand for carpenters' and blacksmiths' tools, cheap knives, teapots and cheap kitchen utensils, but on the whole the trade does not amount to much. The principal imports in the above goods come from England (about one-third), France, Germany and Belgium. The demand for iron rafters is increasing; last year some $16,000 worth of them were imported from England. I went through several stores, but did not see any American goods, as I suppose that Morocco has never been tried by our manufacturers. The only "American apparatus" I saw was a windmill, which came from Chicago.

Tangiers is an entirely Moorish town. The population is estimated at about 30,000, of which 8,000 are Jews and perhaps 900 Europeans. There is an electric light company, known as "Compania Trasatlantica," of which a Mr. A. Ortenbach is manager. The light, however, is very poor, and at 10 o'clock in the evening it is turned off. The Moors who can afford it then walk through the streets with "candle lanterns."

The only merchants (in the iron and hardware line) of importance are Braunschvig & Co., with head office at Tangiers, and branches all over Morocco, and Charles Gautsch & Co., of Tangiers.

For machinery and machine tools there is not a great market in Gibraltar. The only engineering works are the "Gibraltar Foundry and Forge," owned and operated by Messrs. J. Carboni & Co. Gibraltar is now lighted by electricity, and the plant is operated by the Sanitary Commissioners, of which institution Col. J. F. Lewis is the chairman and W. F. von Andlau the steam engineer. I think that in small tools we ought to be able to do some business with Gibraltar; the principal merchants in these goods are: James A. Dagnino, Waterport street; E. A. Ferrary, Waterport street; E. Oliveri, Waterport street; R. Parody & Co., Waterport street. Saws, files, rasps, hammers, chisels, as well as small hardware, cutlery, builders' hardware, etc., are almost entirely of English origin. There is also a limited demand for plumbers' gas-fitters' and similar goods, and in this line the principal firms are: Stewart & Co., Gunner's Lane; Louis M. Dotto, Governor's street; Manuel Sodi, City Mill Lane.

Gibraltar has also a telephone service, owned and operated by Mr. James A. Dagnino.

Crossley Bros., Ltd., of Manchester, have just established an agency at Gibraltar for their gas and oil engines, and by proper efforts something may be done in that line, though the demand, at least at present, is very small. Another article the importation of which has begun are steel ceilings.

Of the above-mentioned firms, A. E. Ferrary carries American stoves. He also deals in bar and sheet iron, hoop iron, brass, steel and copper rods, tinware, firearms, etc.

The Gibraltar Gas Company keep stock

in chandeliers, brackets, hall lamps, gas grillers, burners, Bunsen tubes, brass, iron, block tin, and rubber tubing, globes, etc. Gas ovens are also supplied by the company.

The Gibraltar Foundry and Forge (J. Carboni & Co.) are quite busy. They are ship repairers, boilersmiths, iron and brass founders, and keep a complete stock of materials and engineering requisites on hand.

Sevilla, Spain, is not much of an industrial city. There are several engineering works, but the work turned out by them leaves very much to be desired. I went all over the shops of a prominent company engaged in the manufacture of steam engines and boilers. The tools used in the shops are simply terrible. In the blacksmith shop I saw a steam hammer built in 1862 by the Govan Iron Works, of Glasgow; it looked like a pile of old scrap, but was still kept busy! Tapping, drilling, planing machines, etc., were almost all of German make, most of them being the make of Ernst Schiess, of Düsseldorf. But they are all antiquated and out of date. The company employs some 250 hands. The engineering works in Sevilla are: Sociedad Anonima Talleres de Portilla, Perez Hermanos, Pando Rodriguez y Ca., Ricardo Garcia Maraver, Manuel Grosso, Daniel Puch, Enrique Gutierrez Diaz.

Guns and war materials are manufactured by the Government works, known as Fundicion de Bronces and Pirotecnica Militar. These works are equipped with modern machinery; only recently the Fundicion de Bronces placed an order for seven lathes.

There is a good demand for small tools; Germany and England supply the market. The American Consul told me that he had never met an American salesman in Sevilla, while German and English commercial travelers can be found all over Spain. The leading wholesale firms, dealing in tools, in Sevilla are: S. Garcia y Ca., Pando Rodriguez y Ca., Santanach y Rubio, Alonso Hermanos, "La Llave"; Fernandez y Hermida. All these firms are of good financial standing. Mr. Martin Marten, who is the principal dealer in machinery and mill supplies in Sevilla, told me that there was a splendid market for American goods, if our manufacturers would only cultivate it.

The company known as Compania Sevillana de Electricidad supplies the city with light and operates the electric tramway. The machinery and everything else is German. Mr. Otto Engelhardt is the director. I called upon him and he took me over their plant. HENRY L. GEISSEL.

Sevilla, Spain.

A Shop Accident Emergency Outfit.

Our readers will recall several articles in our last volume relative to the usefulness of a collection of bandages, plaster, arnica, etc., to be always at hand for use in those accidents which are sure to happen occasionally.

Putnam & Co., of 150 Nassau street, this city, send us a photograph and description of a special emergency cabinet which they have prepared for factory use. The contents of the cabinet and the uses of the various articles are as follows:

Linton Bandages.—An absorbent and soft but firm bandage, to be applied as a direct covering to a wound. Their absorbent property makes them useful in absorbing discharges and also for holding solutions, lotions, etc.

Cotton Bandages.—A collection of plain bandages of various widths.

Iodoform Gauze.—Sterilized absorbent gauze impregnated with an antiseptic. Especially useful for application to bites, stings, burns and bruises. Being a local anesthetic, for iodoform acts to relieve pain.

First Aid for Wounds.—Modeled after the packet used by first aid and humane societies. The contents are a piece of antiseptic lintine, a piece of bandage gauze, a triangular bandage and two safety pins.

Red Cross Gauze.—A square yard of this material is supplied, which is to be cut into convenient sizes and shapes by the scissors with which the case is supplied. Suitable for direct application to a wound.

Absorbent Lint.—A thick absorbent cloth resembling canton flannel in appearance. Used chiefly when solutions, ointments, etc., are to be applied.

Z O Adhesive Plaster.—This is supplied on a spool and needs neither heat nor moisture when used.

Absorbent Cotton.—For absorbing discharges. Supplied in a roll with tissue paper wound between the layers.

Arnica.—Useful, as everybody knows, for bruises, sprains, etc.

Carron Oil.—A combination of lime water and linseed oil. Used as a dressing for scalds and burns.

The various articles are sterilized and sealed from the air.

Hollow Forgings.*

It is necessary that a forging be hollow in order to temper it. There are two ways of making a forging hollow. The ordinary way of getting rid of the center of a forging is simply to bore it out. After boring, it is tempered, and thus the strength is restored which was taken away with the material which was in the center. Another way of getting rid of the center of large forgings is to forge them hollow. A person who has not considered the subject carefully would naturally think that the first thing to do in making a hollow forging would be to cast a hollow ingot. It has been mentioned that there are various defects which occur in ingots, the most serious of which are "segregation" and "piping"; and that it is in the center and upper portion where those defects occur. If an ingot were to be cast hollow a solid core of firebrick or similar material would replace the center metal and instead of one on the outside there would be two cooling surfaces, one on the outside and one around the core, and the position of last cooling would be transferred to an annular ring midway between these surfaces where the "piping" and the "segregation" would collect. This would not be satisfactory, because the metal there is what must be depended upon for the strength of the hollow forging. It is necessary, therefore, to collect the "piping" and "segregation" in the center and at the top, where metal has been added to the original ingot for the purpose.

Then, having cut off the top and bored out the center, the "piping" and "segregation" are entirely eliminated, and what is left is as sound and homogeneous a piece of steel as can be obtained.

After the hole has been bored in the ingot, the next process is to reheat it, and, as before explained, this process is not as delicate a one as if the ingot were solid. The heat affects the center equally with the exterior and the two expand together and the danger of cracking is not incurred. When the ingot is reheated a steel mandrel is put through its hollow center, and subjecting the two to hydraulic pressure, the metal is forced down and out over the mandrel. Thus an internal anvil is practically inserted into the forging and there is, therefore, really much less than one-half the amount of metal to work on than if the piece were solid.

When the work of shaping is completed the forging is reheated to the proper temperature and then either annealed in the usual manner or plunged into a tempering bath of oil or brine, to set the fine grain permanently that has been established by the reheating. A mill annealing follows to relieve any surface strains that may have been occasioned by the rapid cooling.

Hollow forgings oil tempered and annealed are considered the best grade of forgings made, and any forgings made otherwise, although they may be suitable for the service to which they may be applied, cannot be looked upon in any other manner than as of an inferior grade.

*H. F. J. Porter, before the Engine Builders' Association.

The proceedings of the International Navigation Congress at Düsseldorf, which we have before mentioned, are to be published in German, French and English, and it is suggested that a membership of the congress, even without attendance, will be quite desirable for those who would possess the valuable collection of papers.

An experimental balloon recently sent up at Berlin reached a hight of over 12 miles and recorded a temperature of 80 degrees, Fahr., below zero.

A Ready Construction of the Ellipse.

BY W. S. BUVINGER.

The writer is not unacquainted with the several graphical methods for the construction of the ellipse. Some of them are mathematically correct and others are approximate. In any case their use demands that the draftsman must retain the method in his memory or make a reference to it in an engineer's pocket book.

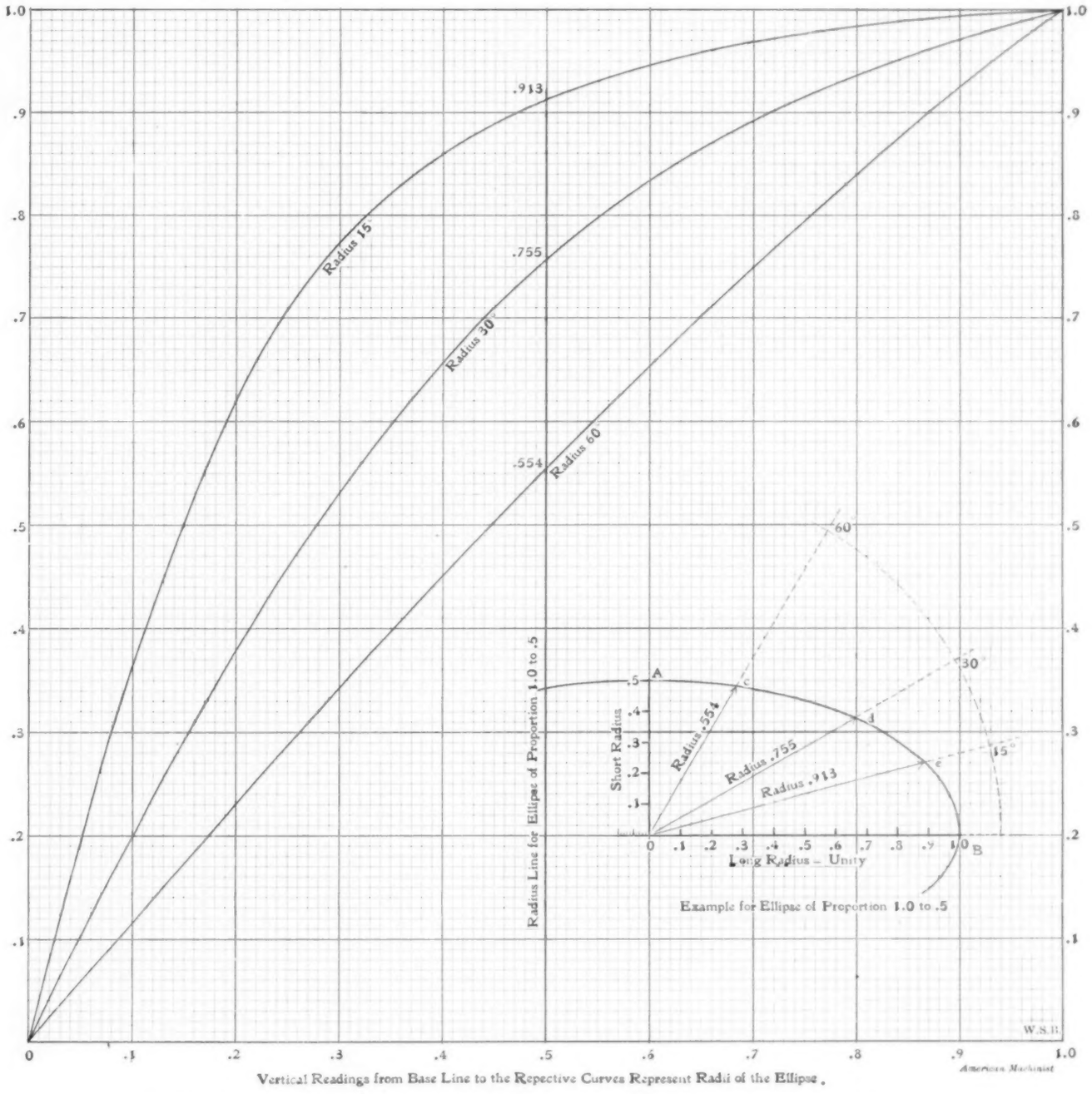
Various mechanical devices involving mathematical principles have been constructed, with greater or less claims to merit. All of them are expensive in construction and have had not very extensive use.

In order to permit a ready construction of the ellipse, sufficiently accurate for most mechanical work, it occurred to the writer that curves could be constructed to graphically represent radii from the ellipse center. Such radii can be drawn at the angles of 60 and 30 degrees of the draftsman's triangle, and a quick reference to the author's curves gives the length of the same. Three points between the ends of the axes of the ellipse are indicated, thus allowing the construction of the whole curve by use of the draftsman's scroll.

To find these points of the curve at 60, 30 and 15 degrees, as shown, we first express the short radius as a decimal fraction of the long radius. For instance, suppose the long radius to be 5.0 and the short radius 3.25, to construct the ellipse. The decimal relation of the short radius to the long radius would, of course, be $\frac{3.25}{5} = .65$. The perpendicular from the base line of the plate to the curves at the point .65 gives as radius lengths, 60° = .702, 30° = .864, and 15° = .957, expressed as decimal parts of the long radius.

An example is shown giving points for an ellipse of proportions 1 : 2, or ½ = .5. Reading from the plate at the point .5, we readily ascertain the radius lengths, 60° = .554, 30° = .755, and 15° = .913, from which the ellipse is constructed by use of the draftsman's irregular curve.

These reference curves have been constructed from mathematical calculation and are sufficiently accurate for ordinary work.



CURVES GIVING RADII FOR ALL ELLIPSES AT ANGLES OF 15, 30 AND 60 DEGREES, MEASURED FROM THE CENTER LINE.

The Premium Plan at the Blank Blank Engineering Works.

We have from time to time published various tables of figures showing the results obtained with the premium plan. These tables have been instructive and at the time of their publication were as comprehensive as could be obtained. They gave, however, the results on individual pieces, and while we believe those results to have been fairly representative of average cases, it it not to be denied that such results are apt to be looked upon with suspicion, the reader feeling that even with the fairest intentions on the part of the compiler of the data, such results cannot be looked upon as presenting the workings of the system in a comprehensive manner.

By great good fortune on our part and with conspicuous liberality on the part of the corporation which supplies the data, we are enabled to present some figures which show in detail and in summary the workings of the plan as a whole in a plant which employs about four hundred men in all departments and in which the entire work, so far as the machine shop is concerned, is done under the premium system. The first of the accompanying tabular exhibits shows the results obtained in time saved and in total premiums earned for the entire machine shop during a period of thirteen months, together with the total number of premium jobs completed during each interval given in the table, these intervals being one week in all cases except the first, which covers nearly six weeks. The totals are given for the first seven months, for the second six months and for the entire thirteen months. The first seven months cover the period of installation and during this period the number of premium jobs was naturally smaller than during the second period and the results for the second period are naturally better than for the first or for the entire thirteen months, although the differences are not great. To exhibit these differences in a comprehensive manner the ratios at the bottom of the table have been worked out on all three bases. While these ratios for the entire thirteen months possess an element of satisfaction due to the length of time included, we think it will be accepted nevertheless that the fact that this interval includes the initial stages of the system makes the second half of the year the better illustration of its working. The table needs no further comment.

Table 2 shows the effects of the system in reducing cost and increasing output. The figures for this table are taken from the cost sheets and give the time and wages spent in producing two lots of one hundred complete machines each—one lot having been made by day's work and the other under the premium plan. Figures are given for each operation on each piece, for the pieces as a whole and for the complete machines, including the final assembling.

This table, like the other, needs no comment except the general one that the manager of these works believes that prior to the adoption of the premium plan his output was being systematically held up by his men who, he believes, were intentionally restricting production. The gains due to the workings of the premium plan under these circumstances are of course greater than would be obtained in shops where there had been no such restriction; and to that extent the tables show results which could not usually be expected. On the other hand, it is certainly to the large credit of the plan that it broke up this practice in this case.

Pay Period.	Number of Jobs Completed	Totals of Time Limits. Hours.	Totals of Time Taken. Hours.	Totals of Time Saved. Hours.	Totals of Premiums Earned. Dollars.
Feb. 19 to March 31, 1901	105	6,873	4,890¼	1,982¾	236 61
March 31 to April 6, "	23	1,510¼	1,053½	456¾	56 65
April 6 " 13, "	34	2,085¼	1,553	532¼	63 40
" 13 " 20, "	49	2,936	1,972¾	963¼	117 13
" 20 " 27, "	36	5,212	3,365¼	1,846¾	190 90
" 27 May 4, "	78	5,345¼	3,651½	1,693¾	193 83
May 4 " 11, "	50	5,542¼	3,473¾	2,068½	204 84
" 11 " 18, "	50	4,839	3,063¼	1,775¾	199 89
" 18 " 25, "	84	6,03[illegible]¼	3,821	2,217¼	231 09
" 25 June 1, "	61	4,436¼	2,710¼	1,726	196 19
June 1 " 8, "	78	7,282½	4,055¼	3,227¼	296 97
" 8 " 15, "	70	5,860	3,813½	2,046½	207 34
" 15 " 22, "	80	7,221¼	4,371½	2,849¾	272 58
" 22 " 29, "	82	6,788½	3,964¼	2,824¼	285 48
" 29 July 6, "	61	4,359¾	2,592¼	1,767½	178 24
July 6 " 13, "	44	3,593½	2,234¾	1,358¾	156 45
" 13 " 20, "	95	9,513¼	5,399	4,114¼	396 21
" 20 " 27, "	106	8,298	4,827½	3,470½	327 17
" 27 Aug. 3, "	100	9,343¾	5,499¾	3,844	389 60
Aug. 3 " 10, "	109	10,611¾	5,444	5,167¾	534 01
" 10 " 17, "	115	9,704½	5,513	4,191½	448 16
" 17 " 24, "	123	12,303	6,620	5,683	578 56
" 24 " 31, "	132	11,620¼	6,100	5,520¼	529 43
" 31 Sept. 7, "	93	9,418¾	5,316¼	4,102½	417 08
Sept. 7 " 14, "	84	9,736¼	5,373¼	4,363	401 74
" 14 " 21, "	103	10,925¾	6,179½	4,746¼	526 96
Totals for first seven months	2,045	181,398¼	106,858¼	74,540	7,637 51
Sept. 21 to Sept. 28, 1901	86	12,499¼	6,878½	5,620¾	550 58
" 28 Oct. 5, "	106	9,179¾	5,108¼	4,071½	426 58
Oct. 5 " 12, "	117	13,020¾	7,096	5,924¾	590 86
" 12 " 19, "	115	13,147½	6,767	6,380½	675 87
" 19 " 26, "	100	11,676¼	6,104	5,572¼	594 12
" 26 Nov. 2, "	117	13,051	6,704½	6,346½	652 16
Nov. 2 " 9, "	121	13,082¾	6,649	6,433¾	637 04
" 9 " 16, "	112	12,007	5,899¾	6,107¼	634 00
" 16 " 23, "	74	8,469¾	4,496	3,973¾	404 27
" 23 " 30, "	99	14,686½	7,306¾	7,379¾	729 84
" 30 Dec. 7, "	131	14,977½	7,829¾	7,147½	753 33
Dec. 7 " 14, "	138	14,832¾	7,168½	7,664¼	758 37
" 14 " 21, "	138	17,252¼	8,401½	8,850¾	847 01
" 21 " 28, "	123	13,044	6,645¼	6,398¾	599 27
" 28 Jan. 4, 1902	30	3,726	2,094¾	1,631¼	160 53
Jan. 4 " 11, "	51	6,188	3,099¾	3,088¼	326 87
" 11 " 18, "	84	11,258¼	6,033	5,225¼	466 26
" 18 " 25, "	165	18,179¼	9,133¼	9,046	856 39
" 25 Feb. 1, "	153	16,576¾	8,525¾	8,051	705 94
Feb. 1 " 8, "	130	17,948¾	9,248¾	8,700	841 35
" 8 " 15, "	134	15,465¼	7,515	7,950¼	683 45
" 15 " 22, "	115	13,584¼	7,247¼	6,337	605 05
" 22 March 1, "	91	8,174½	4,319	3,855½	349 76
March 1 " 8, "	115	12,494	6,702	5,792	501 82
" 8 " 15, "	84	9,522½	5,099½	4,423	323 50
" 15 " 22, "	85	10,670½	5,551¼	5,119¼	427 27
Totals for second six months	2,814	324,714¾	167,624	157,090¾	15,101 49
Totals for entire year	4,859	506,113	274,482¼	231,630¾	22,739 00

	First Seven Months.	Second Six Months.	Entire Thirteen Months.
New time / Old time	$\frac{106,858¼}{181,398¼} = .59$	$\frac{167,624}{324,714¾} = .516$	$\frac{274,482¼}{506,113} = .542$
Average premium earned per hour	$\frac{\$7,637.51}{106,858¼} = 7.16$ cts.	$\frac{\$15,101.49}{167,624} = 9$ cts.	$\frac{\$22,739.00}{274,482¼} = 8.3$ cts.

Table I.—Summary of Premium Plan Records for Thirteen Months.

THE ADMINISTRATION OF THE PLAN.

Shop proprietors and managers everywhere are asking " how is the plan conducted and managed?" and the methods in use at these works will be of corre-

Opr. No.	Piece No.	Wages Cost. Day Work.	Wages Cost. Premium.	Hours Consumed. Day Work.	Hours Consumed. Premium.
1	1	$9 75	$5 15	35	12
2	. . .	49 50	20 20	208	55
3	. . .	26 56	16 50	106	47
4	. . .	6 45	20 05	43	10
5	. . .	20 50	11 35	125	47
6	. . .	16 50	8 03	75	30
7	. . .	16 50	9 50	75	36
8	. . .	56 30	33 00	212	89
9	. . .	25 00	8 47	101	41
10	. . .	14 86	11 00	85	51
	Totals	$241 92	$143 25	1,065	418
1	2	5 00	3 75	26	14
2	. . .	1 76	1 32	10	5
	Totals	$6 76	$5 07	36	19
1	3	20 25	9 27	90	31
2	. . .	13 12	10 76	75	48
3	. . .	19 42	14 12	125	58
4	. . .	2 50	1 75	15	10
5	. . .	96	64	6	2
6	. . .	75	65	10	8
7	. . .	8 00	5 36	50	17
8	. . .	52 00	30 00	200	125
	Totals	$117 00	$72 55	571	299
1	4	15 00	12 00	60	40
1	5	78 00	44 43	300	95
2	. . .	18 20	12 20	70	30
3	. . .	23 40	21 19	90	73
	Totals	$119 60	$77 82	460	198
1	6	78 00	44 43	300	95
2	. . .	2 50	2 00	24	16
3	. . .	14 00	11 60	70	46
4	. . .	20 00	19 50	85	75
5	. . .	130 00	90 89	500	200
	Totals	$244 50	$168 42	979	432
1	7	12 25	9 93	70	43
2	. . .	17 48	12 55	70	30
3	. . .	4 00	3 50	20	15
	Totals	$33 73	$25 98	160	88
1	8	200 00	140 00	800	200
2	. . .	5 75	5 00	32	27
3	. . .	4 00	1 75	30	15
	Totals	$209 75	$146 75	862	242
1	9	2 25	2 00	14	10
1	10	8 00	7 00	36	24
2	. . .	5 12	4 00	32	19
	Totals	$13 12	$11 00	68	43
1	11	2 56	1 92	16	8
2	. . .	16 20	11 98	72	34
3	. . .	5 30	3 96	20	10
4	. . .	2 12	1 56	12	6
5	. . .	8 75	6 68	50	25
6	. . .	11 25	9 50	50	34
	Totals	$46 18	$35 60	220	118
1	12	$1 80	$1 38	12	6
2	. . .	2 60	2 10	13	8
3	. . .	1 40	96	8	3
	Totals	$5 80	$4 44	33	17
1	13	3 85	2 45	22	14
2	. . .	6 00	4 30	40	18
	Totals	$9 85	$6 75	62	32
1	14	65 00	31 87	260	95
2	. . .	25 00	14 43	100	41
3	. . .	4 08	3 00	24	13
4	. . .	3 50	3 00	20	14
5	. . .	9 10	6 00	35	14
6	. . .	9 98	7 70	40	24
7	. . .	5 62	4 75	45	36
	Totals	$122 28	$70 75	524	237
1	15	12 50	9 00	50	23
2	. . .	6 50	3 06	25	9
3	. . .	7 00	5 20	35	20
4	. . .	5 25	4 06	35	18
5	. . .	1 40	1 00	8	5
	Totals	$32 65	$22 32	153	75
1	16	8 75	7 50	35	25
2	. . .	9 10	7 28	35	21
3	. . .	27 00	19 73	150	80
4	. . .	65 00	29 36	225	110
5	. . .	37 50	28 50	150	109
6	. . .	31 25	23 30	125	60
7	. . .	13 84	7 13	62	31
8	. . .	62 50	37 59	250	114
9	. . .	2 10	1 59	12	6
10	. . .	12 75	9 86	75	41
11	. . .	6 12	4 39	35	15
12	. . .	11 25	9 33	75	49
13	. . .	5 10	3 86	30	15
14	. . .	8 00	5 58	50	20
	Totals	$300 26	$195 00	1,309	696
1	17	1 00	89	10	5
2	. . .	11 25	10 38	125	115
3	. . .	18 75	14 47	125	68
4	. . .	18 75	14 73	125	74
5	. . .	45 00	39 66	200	152
6	. . .	5 40	4 99	60	58
7	. . .	30 00	23 40	150	84
8	. . .	30 00	23 04	250	144
9	. . .	15 00	10 65	100	42
10	. . .	1 25	1 11	14	12
11	. . .	2 40	2 22	12	10
12	. . .	80	62	8	5
	Totals	$179 60	$146 16	1,179	769
1	18	3 75	3 27	15	11
2	. . .	6 25	4 70	25	13
3	. . .	7 00	5 93	40	28
	Totals	$17 00	$13 90	80	52
1	19	5 62	5 09	25	20
1	20	3 50	2 98	20	14
1	21	4 25	3 42	50	30
2	. . .	10 62	7 04	125	45
	Totals	$14 87	$10 46	175	75
1	22	$0 15	$0 10	2	1
2	. . .	2 70	2 13	18	10
3	. . .	3 30	2 63	22	13
4	. . .	3 32	2 31	19	8
5	. . .	2 62	1 76	15	6
6	. . .	5 00	3 47	25	10
7	. . .	5 00	3 44	25	10
	Totals	$22 09	$15 87	126	58
1	23	2 00	1 66	10	6
1	24	3 40	3 18	24	18
2	. . .	15 00	10 13	100	40
3	. . .	5 00	3 98	25	14
4	. . .	2 50	1 88	20	10
5	. . .	1 20	1 00	12	8
	Totals	$27 10	$20 17	181	90
1	25	4 80	3 30	54	26
2	. . .	17 50	13 75	175	100
3	. . .	12 50	8 75	125	50
4	. . .	33 12	27 55	125	83
5	. . .	12 37	10 29	55	36
6	. . .	5 77	4 46	33	18
7	. . .	5 25	3 85	30	14
8	. . .	13 50	12 03	60	47
9	. . .	26 50	17 75	100	58
10	. . .	2 25	2 00	25	22
	Totals	$133 56	$100 73	782	454
1	26	3 60	2 75	16	9
2	. . .	2 25	1 79	10	6
3	. . .	5 62	3 75	25	17
4	. . .	6 40	5 00	40	26
5	. . .	1 00	90	12	10
6	. . .	2 00	90	25	13
	Totals	$20 87	$15 09	128	81
1	27	13 25	9 93	50	25
2	. . .	6 25	4 97	25	15
3	. . .	6 50	4 71	25	11
4	. . .	11 25	8 69	75	38
	Totals	$37 25	$28 30	175	89
1	28	25 00	16 60	250	82
2	. . .	51 00	36 78	425	188
3	. . .	30 00	23 60	300	172
4	. . .	10 00	7 20	100	44
	Totals	$116 00	$84 18	1,075	485
1	29	26 70	19 07	267	114
2	. . .	18 75	12 62	150	52
	Totals	$45 45	$31 69	417	166
1	30	7 42	5 96	33	20
2	. . .	3 37	1 13	15	5
	Totals	$10 79	$7 09	48	25
1	31	195 00	148 20	750	390
2	. . .	45 50	34 29	175	88
3	. . .	7 87	6 08	35	23
4	. . .	4 00	2 96	25	12
	Totals	$252 37	$191 53	985	513
	Grand Totals	2408 72	1674 60	11982	5862

$$\frac{\text{New wages cost}}{\text{Old wages cost}} = \frac{1,674.60}{2,408.72} = .696$$

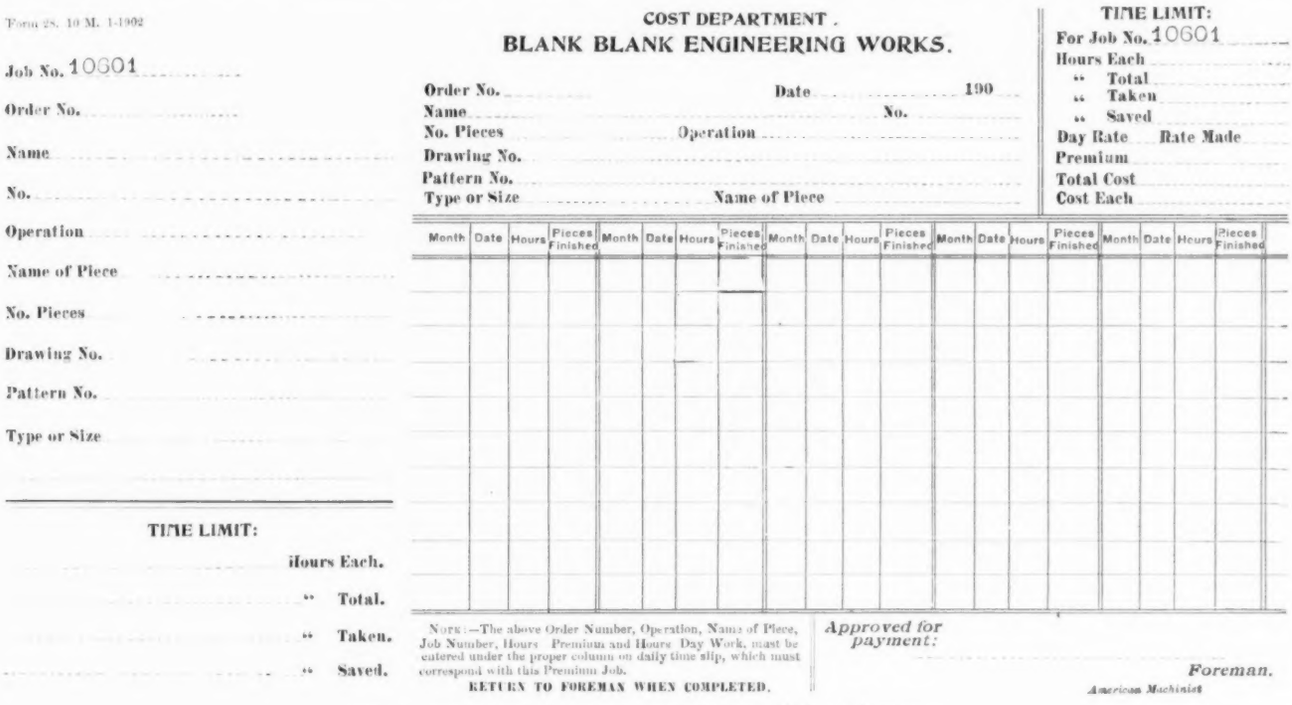
A reduction in wages cost of 30.4 per cent.

$$\frac{\text{New time}}{\text{Old time}} = \frac{5,862}{11,982} = .49$$

An increased production of 104 per cent.

TABLE II.—TIME AND WAGES COST OF 100 COMPLETE MACHINES UNDER DAY'S WORK AND THE PREMIUM PLAN.

sponding interest. They are extremely simple, as is shown by the fact that the keeping of the pay-roll and the cost and premium accounting and management require but one man and two assistants, the latter of whom find time for considerable additional clerical work. The total number of men employed, as already stated, is now about four hundred and the business done exceeds a million dollars a year.


Form 28. 10 M. 1-1902

Job No. 10601

Order No.

Name

No.

Operation

Name of Piece

No. Pieces

Drawing No.

Pattern No.

Type or Size

TIME LIMIT:

Hours Each.

" Total.

" Taken.

" Saved.

COST DEPARTMENT.

BLANK BLANK ENGINEERING WORKS.

Order No. Date 190

Name No.

No. Pieces Operation

Drawing No.

Pattern No.

Type or Size Name of Piece

TIME LIMIT:

For Job No. 10601

Hours Each

" Total

" Taken

" Saved

Day Rate Rate Made

Premium

Total Cost

Cost Each

Month	Date	Hours	Pieces Finished	Month	Date	Hours	Pieces Finished	Month	Date	Hours	Pieces Finished	Month	Date	Hours	Pieces Finished	Month	Date	Hours	Pieces Finished

NOTE:—The above Order Number, Operation, Name of Piece, Job Number, Hours Premium and Hours Day Work, must be entered under the proper column on daily time slip, which must correspond with this Premium Job.

RETURN TO FOREMAN WHEN COMPLETED.

Approved for payment:

Foreman.

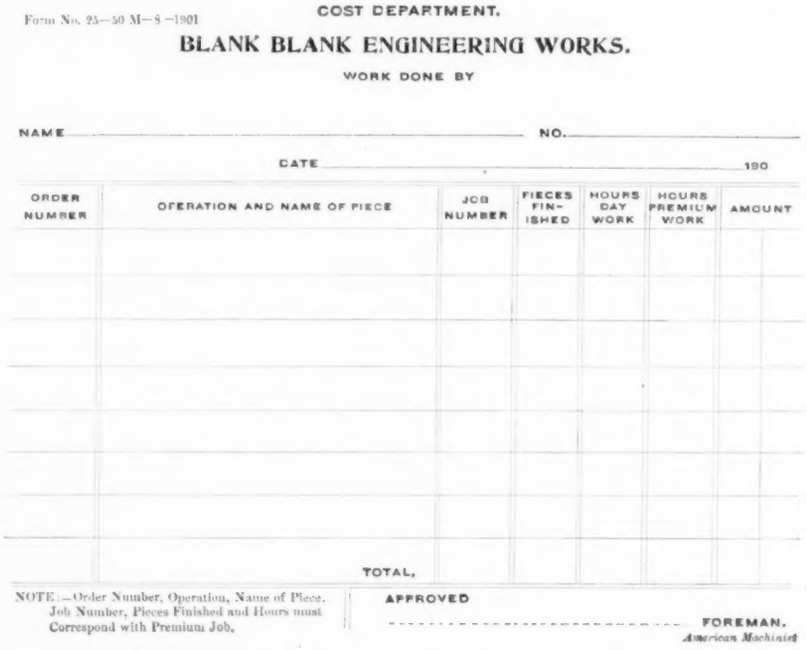
American Machinist

FIG. 1. JOB TICKET AND STUB. ACTUAL SIZE 6¼X11½ INCHES.

A difficulty in the conduct of the system which has been found by several, including the inventor of the plan, appears to be well met by the methods here followed. This difficulty has not, we believe, been mentioned in print before, and certainly no method of overcoming it has been shown. Indeed, until quite recently, the inventor was not aware that others had encountered it. Of late it has, however, been mentioned by several and the publication of a method of overcoming it is therefore quite timely.

The difficulty referred to is that of ambiguity in the time tickets due to the use of indefinite language by the men in making out the tickets. The term "lathe work," for example, will be used for all kinds of lathe work and without anything to indicate just what has been done, where the work began or where it ended. Lines of distinction must of course be drawn between different operations on the same piece and these lines must be observed in the time tickets, but it has been found difficult to get these distinctions before the men or to get them to realize the necessity for observing them.

There are but two special printed forms connected with the premium system as here conducted, and as one of these is the daily time ticket which would be necessary without the system, the system can be fairly charged with but one printed form which is shown in Fig. 1. These forms are bound in a book and have as shown a stub with perforations, check-book fashion. On the receipt of a production order from the office by the foreman of any department, he fills out one of these forms for each operation and gives it to the workman, who retains it until the work is finished, entering each day the time to be charged against the job. The form may hence be called a job ticket. The entry for the name of the piece and of the operation is taken by the foreman from a list which originated in the cost department. This list also contains the premium list from which the initial entries at the upper right-hand corner of Fig. 1 are made. The workman's daily time ticket is shown in Fig. 2 and on it the time to be charged to each job worked upon during the day is also entered. The note at the lower left-hand corner is the solution of the difficulty under consideration. As will be seen, the workman is given on his job ticket the proper job and operation names and these he is required to use in making


Form No. 25—50 M—8—1901

COST DEPARTMENT.

BLANK BLANK ENGINEERING WORKS.

WORK DONE BY

NAME NO.

DATE 190

ORDER NUMBER	OPERATION AND NAME OF PIECE	JOB NUMBER	PIECES FINISHED	HOURS DAY WORK	HOURS PREMIUM WORK	AMOUNT
	TOTAL.					

NOTE:—Order Number, Operation, Name of Piece, Job Number, Pieces Finished and Hours must Correspond with Premium Job.

APPROVED

FOREMAN.

American Machinist

FIG. 2. DAILY TIME TICKET. ACTUAL SIZE 5½X7 INCHES.

out the daily ticket. As these names went from the official list to the job ticket, it follows that the names which come back to the cost department on the daily ticket are the same as those which left it on the official list.

This method of dealing with this difficulty was devised by the man who has charge of the work because he had encountered it in another works where he had had charge of the system, and he states that it is an entirely satisfactory solution of the difficulty.

The entries on the job ticket form the workman's continuous record of his work. In case a given job is interrupted by another, there is a gap in the record, which, however, causes no confusion. When the work is done the record is complete and the ticket goes to the office. Meanwhile as the daily time tickets are sent to the office each morning, their charges against the various jobs are entered upon the backs of the stubs, Fig. 1, and when, on the completion of the job, the job ticket is turned in its entries are compared with those on the back of its stub.

A further use is made of the daily time ticket which is, we think, unique. Its total is compared each day with the record of the time clock and any errors are corrected at once. No further use is made of the time clock record, nor is any payroll in the usual sense of that term kept. The men being numbered in series, the tickets for each day are arranged in numerical order, six files thus accumulating during the week. When the pay list is to be made up for the week the tickets are rearranged so as to get each man's tickets together —this assorting being made easy by the numerical arrangement of each day's tickets. With each man's tickets in a pile his time for the week is added up and the wages due him are calculated. Any premiums which have been earned during the week will be shown by the job tickets which have been turned in. Such premiums are added to the wages due and the total only is entered in the pay list. The tickets are kept for a reasonable length of time, until any disputes have been settled, and in case of such disputes reference is had directly to the tickets, which the workman cannot question, as they were *made out by his own hand* and each one was checked the day after it was made by reference to the time clock record. With the smallest possible amount of bookkeeping this plan seems to provide for all contingencies except that of a lost ticket, and in such a case the time clock record is appealed to.

At the same time that the pay list is made up the total wages and premiums chargeable to each job completed during the week are entered upon a cost sheet for each lot of machines in progress. The sheet gradually fills up as the work progresses, and when the lot of machines is finished the sheet forms the permanent record.

The only criticism to which the method shown is open would seem to be that the workman makes out his own tickets and may charge his time unfairly. This objection is minimized in this case by the fact that all regular work in the shop is on premiums and the inducement to charge time to one job which belongs to another is not present to the extent that it is when part of the work only is on premiums. With a reasonable amount of watchfulness difficulties of this kind do not arise.

Our readers will understand that the blind title to this article is due to the desire of the corporation which furnishes the data to remain unknown. This desire cannot be criticised and for our own part we consider it privilege enough to be allowed to publish such records without naming the source from whence they came.

From a Designer's Note Book.

A RAPID TRANSIT NUT.

The new line of calipers and dividers with split nuts, hardened screws, etc., brings to mind an old caliper on which a rapid transit, yet solid, nut was used. The sketch, Fig. 1, tells all about it worth relating, although it may be said that to my personal knowledge one has been in almost daily use for nearly a score of years and that it does not slip or show signs of approaching dissolution from the constant wear. As a matter of fact, it has *more* thread in contact with its screw than the average of the split variety, without being longer, and never does it fail to right itself promptly when the spring pressure comes against the washer at its concave inner end.

It is a solid one-piece affair with two holes through it: one central and straight-threaded to fit the screw, the other central at its median line, but at an angle to the other, and large enough for the screw to pass through readily, when the spring tension is released and the nut operated. It is cheap in construction, effective in operation and certainly not liable to get out of order.

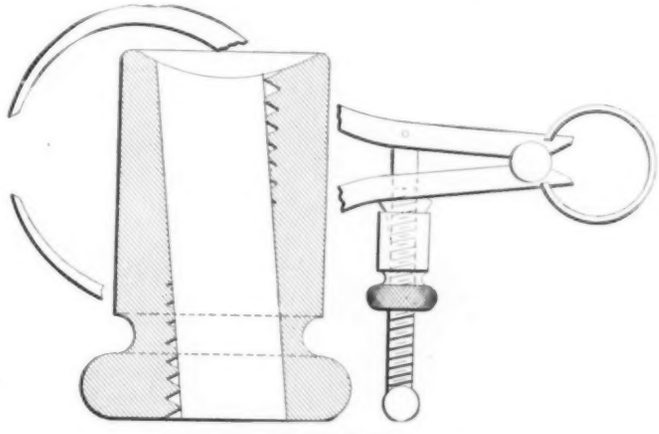


FIG. 1. A RAPID TRANSIT NUT.

A UNIVERSALLY ADJUSTABLE ROD CLAMP.

An old device of common application is a split sphere, Fig. 2, for holding things that can be mounted upon a rod or bar which it is desirable to raise or lower, turn around a complete circle or any part of it, set at any angle—less than 45 degrees—from perpendicular, and clamp in any of these positions rigidly, quickly and easily. It is a device hard to beat. The patent having expired it is common property, and may be found useful in its application to vises for die sinkers, engravers' stands, various rests, guides and other purposes in which provision must be made for a wide range of adjustment and positive immovability when the correct adjustment has been effected.

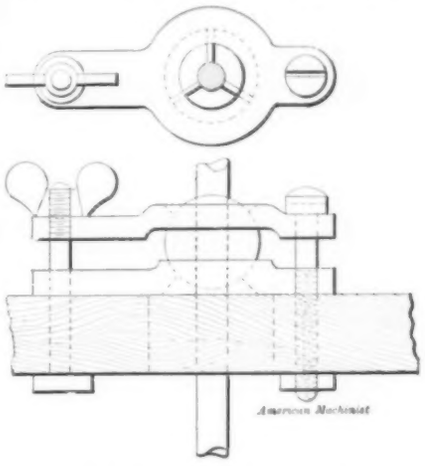


FIG. 2. A UNIVERSAL ROD CLAMP.

The action may be expressed as that of a compound triple wedge and the holding power thus obtained is prodigious as compared with the force or power applied to the clamping screw.

Manifestly it is not affected by position, may be placed pendant, reversed from that shown, or horizontally with equal efficiency. The diameter of the rod used may be about 30 per cent. of the sphere, which can be recessed or chambered out and need not be an accurate fit in its seat.

VENTILATING PULLEYS.

Many years ago an engineer was called

upon to give advice about keeping the belt on a certain pulley, about 18 inches in diameter, 10-inch straight face, running at about 400 revolutions per minute. The owners have tried all the means they knew

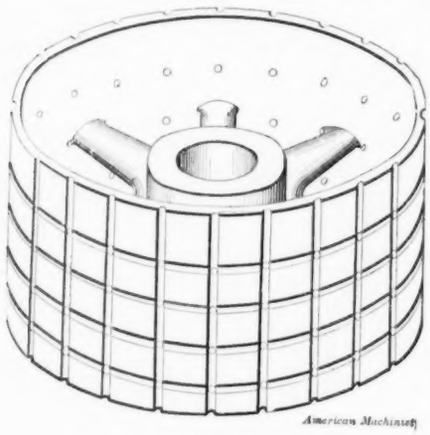


FIG. 3. A VENTILATED PULLEY.

of, but, do what they would, the belt insisted upon running either to one side or the other and constantly slipping. The engineer thought the trouble was caused by an air stratum, entrained between the belt and pulley surfaces, forming a cushion upon which the belt floated. To allow the air to escape freely and obtain better contact, he directed a series of shallow grooves to be turned on it (Fig. 3), with similar grooves cut across its face and holes drilled entirely through at the intersections. Although the owners were rather skeptical as to the results, they had the work done, and found the erratic behavior of the belt to have ceased.

Such ventilated pulleys are now a regular article of trade, except that a series of

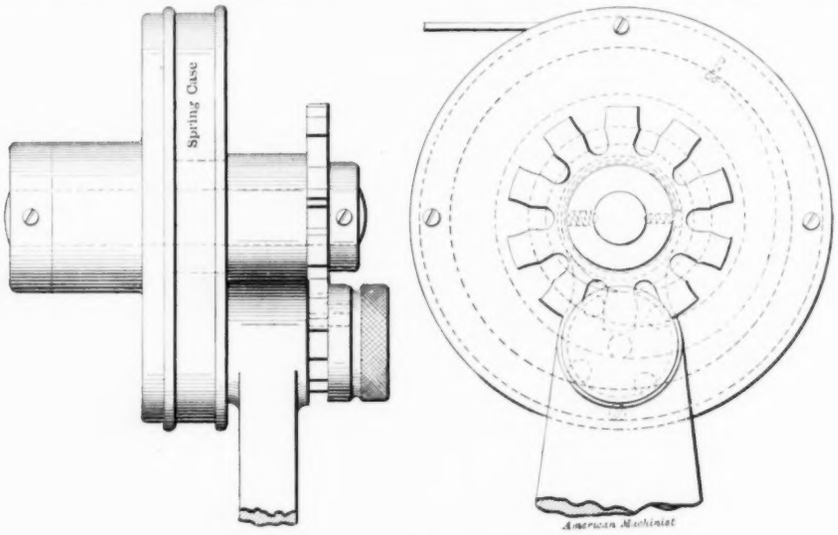


FIG. 4. A GENEVA STOP.

milling cutters is used to produce elongated holes in place of the grooves, the milling scheme being the subject of a patent and the product called "Para-Pneumatic," for which strong claims are made, apparently well substantiated, for high-speed work.

A GENEVA STOP.

The form of the Geneva stop shown here (Fig. 4) has its particular field of usefulness in winding or unwinding a flat coiled spring. It takes the place of the usual key, or wrench and pawl or other detent, with added advantages of its own, holding the spring shaft opposed to the tension given it by the spring at any desired point and affording a ready and convenient means of increasing or decreasing the tension thereof at will without any possibility of its slipping and running down.

As here shown, the broken stand has at its upper end a bearing for a shaft; upon this is loosely mounted a spring case or hollow drum; on the periphery of the drum may be attached and wound the tape or cord used for conveying the tension or pull of the spring, one end of which is fastened inside the spring case while the other is attached to the shaft.

If the shaft is turned, which it may be

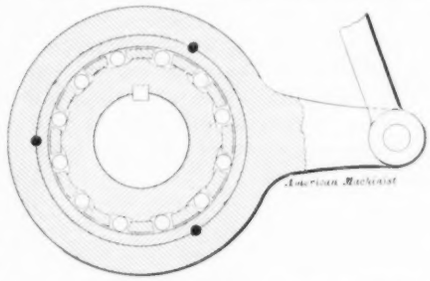


FIG. 5. SILENT REVERSIBLE ROLLER RATCHET.

by the pins on the knurled knob meshing into notched disk, the spring may be wound or unwound, thus varying the tractive power of the cord. The angle of approach of the teeth on the notched disk, to the pins on the knob and its central stud, is such as to positively lock it at every tooth, in either direction unless the knob is turned, which may readily be done, notwithstanding the tension it may be under on account of its greater relative leverage. Whoever may make use of this controlling device will find that the "lay-out" affords an interesting problem in gearing,

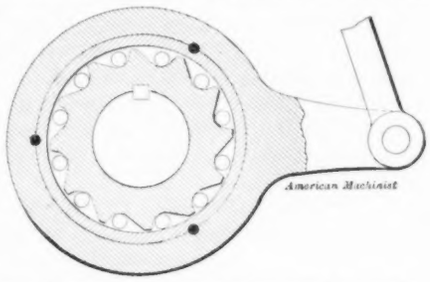


FIG. 6. THE SILENT NON-REVERSIBLE RATCHET.

the forms of which, in this case, may very properly be termed cog wheel and pinion.

A POWER-TRANSMISSION DEVICE.

The noiseless roller ratchet is again brought forward, with certain improvements (Fig. 5), enabling the same ratchet to be used in either direction; that is, to operate a shaft backward or forward at will, or to transform the action of a crank or reciprocating slide into a practically uniform rotary motion. To accomplish this the shaft has keyed on it a hardened steel collar, in this case 5 inches in diameter by 3 inches long, having ground on its periphery twelve evenly spaced longitudinal grooves, ⅛ inch deep by ⅝ inch wide at their bottoms, with the sides flaring outward, at an angle of about 12 degrees, to meet the circumference. In these grooves lie ½-inch hardened steel rollers or pins, separated by and contained in a brass cage, which is so arranged that it is obliged to positively turn with the collar, and, furthermore, is adjustable thereto, either central between the slots or grooves or slightly to either side of the center. No strain is brought to bear on the cage, its function being simply to guide and control the rollers, keeping them in line and in relation to the desired working side, at a time when they are free from working contact.

Surrounding the rollers is a hardened steel ring encased in a casting having an arm to which is attached the connecting rod. The ring is an easy fit over the rollers when they lie in the centers of their seats; but if the cage is advanced so that the rollers have less freedom on the forward movement of the ring, they move forward upon the inclined edge, at once wedging and locking the ring to the collar. Further forward movement is thus imparted directly to the shaft; the amount of lost motion is determined by the relative position of the cage. Obviously, if the cage is caused to recede, the rollers will lie closer to the back of the grooves, so that a pull of the connecting rod has no effect except to loosely turn them; but a push of the rod causes a corresponding movement of the collar, and hence of the shaft.

The return movement, in whichever direction the rollers may be placed, loosens them instantly. It is evident that two of

these collars on the same shaft, with a connecting rod for each, arranged on opposite sides of the shaft and operated from the same center, would give a continuous straight forward motion in whichever direction the oppositely disposed cages might be set, for while one is pushing the other is pulling free, or *vice versa,* so that a regular reciprocating motion of rods of equal length gives a lead of one over the other to such an extent that the turning movement of the shaft is fairly uniform and constant, and there is not the intermittent, step-by-step action that naturally would be expected.

This arrangement of double angled grooves and cage is the subject of a patent granted to Geo. S. Strong, of New York; hence is not available to the public.

But that shown in Fig. 6 is the old style, in common use for many years, and while it lacks the feature of reversibility, possesses enough of the characteristics of the other to warrant its adoption in many cases where a silent, powerful, smooth-acting ratchet, more or less continuous in its operation, is desirable. W.

A New Compound for Welding Steel.

The following is the formula for a recently patented composition to be used in welding steel: Iron chips, 85 pounds; boracic acid, 15 pounds; gelatin, 6 ounces; water, 1¼ quarts. The gelatin is to be dissolved in the water by heating together and then added to the iron chips and thoroughly mixed. Then add the acid and mix thoroughly. (The gelatin is merely to make the acid adhere to the iron.)

The inventor says that by the use of this compound steel can be welded as easily as iron. He remarks further that "a composition containing borax when placed on hot steel crawls off, making it necessary to repeat the operation and requiring careful handling to prevent the compound from falling off, whereas by the use of boracic acid the compound adheres to the steel, even if the latter is placed in the fire in an inverted position, and with boracic acid steel welds at a lower heat than with borax, and thus lessens the chance of overheating the steel." Charles Pangborn, Kalamazoo, Mich., is the inventor.

A news bulletin issued under the sanction of the St. Louis World's Fair authorities says: "The very ingenious 'perpetual motion' invented by Daniel Quinn, an aged mechanic, for display at the World's Fair, consists of a tank of water through which an endless chain of hollow cylinders runs, entering at the bottom between rubber lips, going out at the top and down the outside. He depends upon the buoyancy of the cylinders to keep them in motion and to overcome the water pressure at the point of entrance." Of course the only thing to be said of this is that Mr. Quinn depends upon something in which no dependence is to be placed.

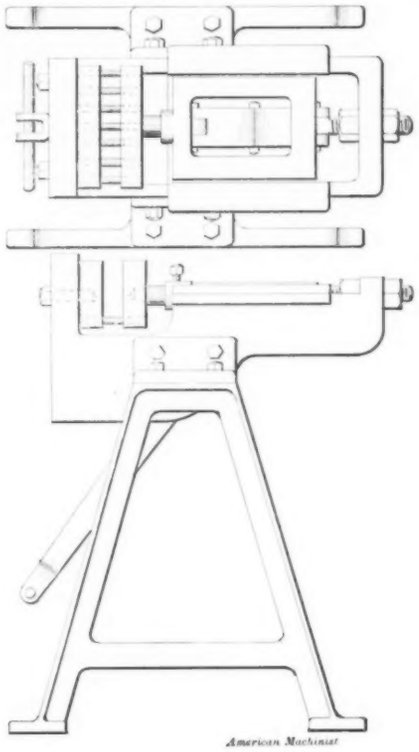
Letters From Practical Men.

A Chilling Plate Press.

Editor American Machinist:

There have been lately in the AMERICAN MACHINIST several articles relating to the hardening and tempering of steel. Perhaps the "chilling plate" process for the hardening of flat, thin articles may not be familiar to some of your readers, although, as is claimed for everything else under the sun, it is not new.

The sketch shows a rig which was improvised for this purpose and worked very satisfactorily. The pieces which had before given much trouble from springing were by this means hardened perfectly flat and straight. A foot-press which had once done its work with dignity and uprightness



A CHILLING PLATE PRESS.

on a bench was turned ingloriously upon its back and supplied with some legs from the scrap heap. Then by taking off the rod connecting the foot lever with the lever running out from the toggle-joint and putting a rod through the hole in the lever it was again in shape to be operated by foot-power.

The "chilling plates" were simply rectangular blocks of cast iron finished true. They were clamped together and a row of small holes were drilled through both along one edge. Pins were driven into one block and the holes of the other were slightly enlarged so that it would slide freely upon the pins. A shank was put in one of the plates to fasten in the slide. The other was bolted to the bed plate, the row of pins being along the under edge. These were to keep the articles to be hardened from falling through when they were dropped in.

In operation the press is opened far enough to allow the hot piece to be easily dropped in edgewise. When it drops upon the pins its top edge topples over to one side or the other and the press is closed as quickly as possible. The press is placed in the horizontal instead of the vertical position, for the reason that if vertical the article would have to be dropped flatly upon the lower plate and being so thin would become cold and crooked before the upper plate could be brought down upon it, while by dropping it in edgewise it touches only at three points at its very edge until the press is closed, flattening the piece while hot and chilling both sides simultaneously. The chilling surfaces of the plates should be coated with heavy fish-oil, and, had it been desirable to use the rig continuously for some length of time, it would have been necessary to have bored or chambered the plates and kept a stream of water running through them, for they soon got too warm to chill properly.

J. W.

Local Case-Hardening.

Editor American Machinist:

Some months ago we found some parts of instruments wearing quite rapidly, and decided to case-harden those in stock before using them. Much to our surprise they failed to harden, although carbonized in our usual manner. A second attempt proved equally futile, and we were scratching our heads over the cause of the failure of the process, when someone suggested that it was because the parts had been nickel plated. While it did not seem probable that a thin coating of nickel would insulate the steel from the carbon, it was decided to test the matter by taking a piece that had been nickeled and buffing off a part of the nickel before carbonizing. This piece hardened all right where the coating had been removed, but remained soft where the nickel was intact.

Further investigation developed the fact that a similar result was being purposely obtained in several factories, where it was desired to obtain local hardening, by copper plating the articles and then buffing off the copper at the points it was desired to harden. The writer has seen hoes and shovels hardened on one side and left soft on the other, with the idea of making them self-sharpening. The work was done by the process just described, and the action was so perfect that the hard and soft portions could be separated by chipping off the chilled side. It was the latter fact that made the tools after all a failure, as they often lost their edges by the separation of portions of the hard metal on striking hard stones in the soil. The process is in use also for hardening cams which require to have some operations performed on them in spots which need not be hard,

when it is most convenient to do these after the working faces have been hardened.

As the nickel-plated parts which led to our investigation had been nickeled over copper, I am unable to say whether the nickel alone would act as an insulation from the carbon, but as it is generally conceded that nickel does not adhere properly to iron and steel without preliminary coppering, an investigation of that matter would seem to be superfluous.

It seems somewhat surprising that a process which admits of such complete control of local case-hardening should be so little known as it is. Its possible applications are so numerous that it would seem as though it would be much more extensively used than it is.

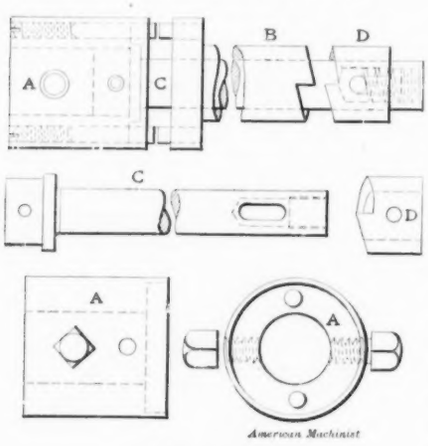
Detroit, Mich. L. O. DANSE.

Die Holder.

Editor American Machinist:

The sketch herewith shows a die-holder that gives the best of satisfaction and can be used on long or short, fine or coarse threads.

The improvement over the old-style die-



DIE HOLDER.

holder is in the backing-off device *D*. When the spindle is reversed, *D*, being held forward by the spring, interlocks at once with sleeve B, thus avoiding the pull which in some die-holders often strips the thread.

All parts, with the exception of the pins, are made of soft steel and case-hardened. As the holder *A* and the spindle *C* are made separately they can be finished all over after hardening, and either part can be replaced. *A* is lapped to the standard size of dies, and *C* is ground all over, a flat being ground on the head so that it can be drilled from *A* when the two parts are put together. The sleeve *B* is ground outside and lapped inside and should be an easy fit on *C*. The driving pins in *B* project the depth of the counterbore in *A*. The pins in A are adjusted to suit the job in hand. H. T. C.

A Volcanic Suggestion from the Foundry.

Editor American Machinist:

Here is a rather curious thing that has come along just in the nick of time. Of course we could not fail to be deeply interested in the stories and pictures which tell of the devastating work on the island of Martinique. We as mechanics are always having to do with the manifestations and applications of physical force, and when we have such a stupendous exhibition of power as Pelee Peak has been giving us, it is a most natural, an inevitable thing that we should all be thinking at once about the cause of the vast phenomenon. We fool ourselves with the idea that we are looking for the cause, but after all the best we can do is to look for the sequence of events and to try to reach as far back as we can along the chain by which one happening is tied to that which immediately precedes it, and so on as far as we can reach, finding still beyond our ken something that starts and keeps things going.

When stones or mud or water are thrown up with force from holes in the ground the handiest thing to suggest as the cause is of course steam. We have no doubt at all about the existence of the central fires, but it is not nearly so easy to tell how the water, which we assume to come in from the outside, can sneak down so far into the interior without being sooner converted into steam and having its force dissipated almost as soon as generated and without being able to accumulate to such a vastly destructive potency.

The first and the handiest suggestion about the action of Pelee is of course the familiar steam suggestion. There was an earthquake movement of some kind which made a crack somewhere in the bottom of the surrounding sea, and the water ran down and encountered the interior fires, and then the blow-out came. The explanation is not a very satisfactory one. We would naturally think that the water or steam would be blown out by the same channel by which it entered, but it evidently was not in this case. Also when the explosion occurred we would naturally look for a lot of steam coming out with or following up the other volcanic material, but in this case there seems to have been comparatively little, if any, steam, while there was a great volume of noxious gases which were presumably the products of combustion. There was unlimited evidence of fire, but little, if any, of steam. There is, we may say, practically little evidence in this case to substantiate the steam theory, although it is very proper to hold to it until some better suggestion is offered.

Now we are ready for our foundry lesson, and it is a curious coincidence that the illustration to which I am calling attention comes to our notice just at this time. Explosions of molds, or the forcible ejection of molten metal from molds in the foundry by the force of steam generated at the instant in the molds are sufficiently familiar. If there is a very small quantity of water or of wet sand anywhere near the bottom of the mold when the molten metal is poured in, the metal is very sure to get out faster than it went in, and usually by the channel of entrance. Molders have learned to look out for and to avoid these sequences of events, so that they are of comparatively infrequent occurrence. When blow-outs of this character do occur the consequences are usually trivial, so far as personal injuries to the molders are concerned.

It happens that just now we have a clear and reliable statement of how a very destructive foundry blow-out or mold explosion occurred, showing clearly that water or steam was not the cause of it. I got the story from *The Mechanical Engineer*, of London. It was in a foundry at Sheffield, and five men were killed and many more were severely burned. The mold was for a large roll weighing 14 tons, cast upright. There was a core in the middle which was made in two pieces, just butted together somewhere near the middle of the length of the roll. It was recognized that when the roll was poured the liquid metal might flow into the joint between the ends of the two cores, thus leaving the upper portion to exercise its full buoyancy when submerged in the molten metal which would flow around it, and accordingly the top of the core was weighted sufficiently to resist this lifting tendency. The top, it seems, was not covered by a single weight, but by two or more which were not securely placed, and in some way they were moved so that there was no weight on the central tube of the core. This tube rose while the pouring was in progress, with the result that a quantity of carbonaceous material forming the interior of the core was suddenly exposed to the intense heat of the iron. No further explanation is necessary. The gases liberated had force enough to blow most of the metal out of the mold and distribute it so widely and copiously over the foundry that many of the unfortunate men were unable to escape.

The accident was thus, it will be seen, quite an unusual one for the foundry, and the explanation of it was not immediately evident, but was the result of a long and patient investigation, although in the end its correctness was well established. It is evidently quite possible to have a similar occurrence in the future with an equally fatal result, so that it is well to tell of it, that foundrymen may remember and heed the lesson and see to it that weights, which are quite an essential element in foundry practice, are always something more than sufficient and always properly secured.

As to the volcano, the case shows the entire adequacy of an explanation which does not call for the agency of water or steam. The usual miniature volcanoes of the foundry are undoubtedly caused by

moisture, but here was one of unusual proportions that was able to do its work, and do it thoroughly, without any steam. It may be just the same with the big volcanoes. When they have an extra big job on hand they may call for more powerful explosives. We know that the fire and the materials from which gases may be immediately generated exist in unlimited quantities, and a little crinkling of the skin of the earth may be sufficient to change their positions and bring them in juxtaposition. I am not here trying to explain volcanic action in any case, but I am giving others a chance to think about it. TECUMSEH SWIFT.

Molding Spiral Gears and Worms—"Breaches of Confidence."

Editor American Machinist:

M. H. Westbrook at page 668 speaks of molders who said they did not know how it was possible to mold spiral gears. In textile machinery foundries in this country this is an every-day occurrence, and ordinary worms, single or multiple threaded, also are molded in the same manner.

I had charge of a shop where many a gross of spiral gears for gas engines were made. Spiral gears are rammed up exactly the same as if they were spur gears, but they are drawn from the sand with a twisting motion, and worms, instead of being parted longitudinally, are molded end up and screwed out of the sand as though from a nut. It is not usual to taper the thread or the teeth. With the fine sand which is used for "facing" the castings come out almost perfect, and in cases where extreme accuracy is not needed are quite as good as cut gears.

In several shops, for molding the heavier

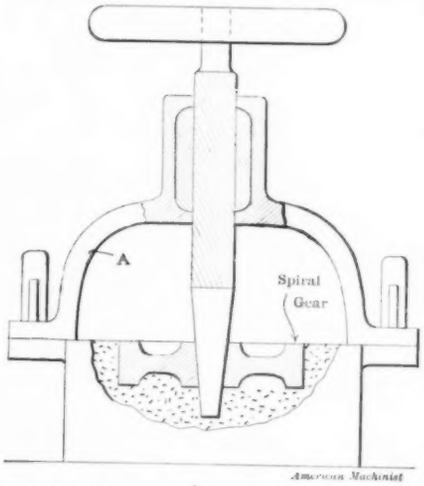


FIG. 1. RIG FOR DRAWING A SPIRAL GEAR PATTERN.

class of gears, which could not, owing to their weight, be steadly drawn, they have an appliance as shown in sketches herewith.

The molding boxes or flasks are planed on the joints, the lugs of the bottom part being flush with the joint, in order that the bracket *A*, Fig. 1, may have a secure foundation. This bracket has fitted into it a screw of the same pitch as that of the spiral gear or the worm, as the case may be, and the nut is of soft metal cast around the screw. The end of the screw is taper in order that it may be forced into the taper hole in the pattern sufficiently tight to draw the pattern upon turning the hand-wheel.

To insure that the drawing tackle be lo-

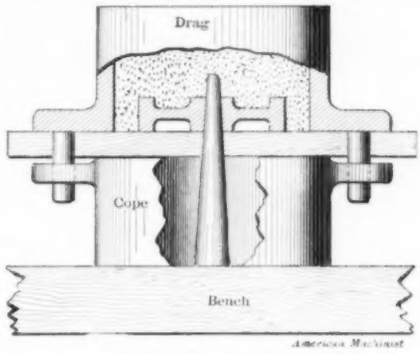


FIG. 2. FIRST MOLDING OPERATION.

cated correctly every time, all the boxes are made interchangeable and the pattern is fixed on a board, as shown at Fig. 2, the taper plug forming a point in addition to being a guide. The whole flask is turned over and the cope rammed up, as in Fig. 3, and the taper plug is withdrawn. After lifting off the top part the appliance for drawing is fixed in position and cottered on after lowering the screw and forcing the taper end into the central hole. It will be noted that a little clearance is allowed in the pin holes to permit of adjustment.

Referring to the "breach of confidence" where one employer informs another that one of the latter's men has applied to him for employment, we have exactly the same thing over here, and perhaps it is more general than with you. A man must actually have left one employer before he can have employment with any other large employer. Since the engineers' strike most of those who have joined the Employers' Federation, upon receipt of an application immediately despatch a form of inquiry to the last or present employers running perhaps as follows:

"*So and so* has applied to us for employment as a *fitter*, informing us that he last worked under *Mr. Shaw* as foreman. We shall be obliged if you will reply to the following questions: 1. In what capacity was he employed? 2. What kind of a workman do you consider him—good, bad or indifferent? 3. Was he steady? 4. Was he a good timekeeper? 5. Would you recommend him as a suitable person for our class of work? 6. How long was he in your employ? 7. When did he leave? 8. Why did he leave? 9. What wages was he receiving? 10. Is he a society man?"

Now, it is quite possible that a man upon asking for a job will never consider that if he states that he is still in employment that any inquiry will be made, or would not have applied, and the chances are that he may not get the new job—his present employers out of spite giving him a poor character, and he may lose his present one. I have known such cases often.

If an employer is liberal-minded he hardly knows how to reply to the form of inquiry. If he should tell the strict truth he might—in the case of a man not suitable for his work—prevent a man suitable for other classes of work getting employment. If he does not reply to it fully, the senders will infer that there is something to keep back. If he should decide to say that on principle he objects to giving the particulars and makes it a rule to return them unfilled, trade relations may become strained. Although I was against filling in this form, I made a compromise, giving them all the information I conscientiously could, but in all cases omitting amount of wages, and in the case of a poor workman stating "not suitable for our class of work."

As to the last question, we always stated "don't know," as in our own case we employed anyone we considered desirable without respect to his "religion." Not a question was asked upon starting a man, and we found often that those who came without references of any kind—probably unable to get them—turned out the best, while many of those who could produce the best lasted only a few weeks—were in fact wastrels. If a man had been used to our class of work that was the only point requisite for possible employment.

If employers would cast aside once and for all this reference business, settling on anyone whom they saw or considered likely to suit them, I believe they would in the long run have quite as model a set of men as they now have—and perhaps better. Personally I judge a man by appearance rather than his "credentials."

In some parts of the country it is customary for employers to be under agreement not to employ on any consideration whatever one another's men. If a man leaves or is "stopped", although he may

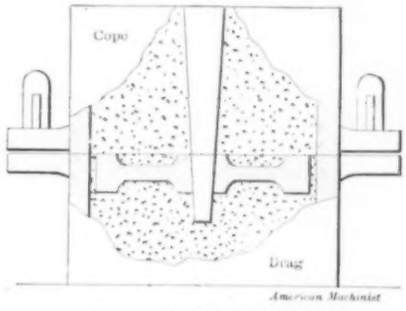


FIG. 3. FINAL OPERATION.

have lived in that part of the country all his life, he must seek a new and strange land. The result of this has been to keep wages down. Molders and patternmakers are rated at 32 shillings ($8) per week, as against 40 shillings ($10) and 42 shillings ($10.50) in the larger towns, and fitters' and machinists' wages range from 25 to 30 shillings per week. This is a very near-

sighted policy on the masters' part, as all the good men leave them at the earliest opportunity, and the common work only falls to their lot. FRANCIS W. SHAW.

Birmingham, England.

Systems and Opinions.

Editor American Machinist:

When I read the columns of the AMERICAN MACHINIST I often wonder what the editor and his assistants think of the vast differences of opinion among the contributors. Of course, we, the readers, see only a fraction of the contributions; but still we have an ample opportunity to put into practice the old dictum, "You pays your money an' you takes your choice."

Now take, for instance, the subject of shop management. "Needle" tells a story about his friend's troubles and is immediately assailed from all sides with criticisms of said friend's course, and after the battle has raged fast and furiously for some time, the friend comes out with some details which had previously been unknown to the opposition, and which not only seem to cut the ground from under the critics' feet, but also to indicate that the friend was wise in his own generation in appreciating that discretion is sometimes the better part of valor, and that it is frequently true that he who fights and runs away will, like the Boers in South Africa, live to fight another day.

Again, there is that highly interesting episode begun by our captivating and ever welcome friend, Tecumseh Swift, with his humorous, yet withal sensible, article on "Splitting up a Foreman." The earnest defense put up by several of the admirers of Mr. Taylor's system is inspiring, and has us almost converted, when suddenly someone shatters our budding faith by rudely telling us that the system is on the wane and all but abandoned in the home of its birth.

Perhaps the secret of this is in the fact that all things have values which are only comparative. To the untutored savage a few glass beads and some gaudy blankets were priceless treasures which he was only too glad to obtain at the loss of a few square miles of worthless forest. To the white man it was the reverse, and to-day the white man's children slave and toil for years to accumulate a little green paper to be bartered for an insignificant fraction of the land which was bought with beads not so many generations ago.

One thing is clear—Mr. Taylor did certainly bring about vast economies in the Bethlehem works. Nobody seems disposed to question that. What is being questioned is simply whether the system is *the best*, or whether it was only less bad than the one which preceded it and which naturally formed the standard of comparison for the measure of improvement. From per onal observation I can testify that it did not require very much of a system to make a good showing as compared to the hit-or-miss methods employed prior to the introduction of the elaborate and much discussed Taylor system. Now, a statement like the above doesn't amount to much without corroborative evidence; so it may be well to point out a few things, some of which are well known to the administrators of the reform and some of which are not.

Beginning with the latter, I feel quite sure that Mr. Taylor doesn't know that under a certain board in the floor of machine shop No. 2 there are buried two shafts, about 2 inches in diameter and, say, 4 feet long, which were spoiled by a lathe hand and reported by him as missing from a lot of ten, the balance of which he shouldered up correctly. Now, Mr. Taylor did unquestionably make it more difficult to perpetrate such frauds as that one on the company; but it wasn't the splitting up of the foreman or any of the original features, the *Taylor* features, of the system which remedied such cases. Any old system that was really a system would have stopped a good many such abuses.

Another item is in the methods previously used for producing certain results. For instance, in the Buffington-Crozier disappearing gun carriage there is a steel ring, say, 15 or 20 feet in diameter, made in sections from about 1x4-inch steel. This ring is provided with notches shaped like an inverted capital letter "U," each notch dropping down over the outer trunnion of one of the conical turntable rollers, and serving, in connection with another ring, to space the rollers properly. These notches were produced by drilling and then slotting out the metal from the edge of the ring to the drilled hole. Of course it was quite impossible to slot accurately enough to bring the straight sides of the slot exactly tangential to the hole, so a lot of filing was needed to smooth up the junction. A milling cutter could have been sunk in from the edge and completed the notch at a single operation in one-third of the time, with probably a better job as the result.

It is quite possible that a careful study of the processes in use might have resulted in improvements which would have reduced costs quite as much as the Taylor system did; and yet we are informed by good and trustworthy people, who are conscientious and honest in their belief, that it is the Taylor system that did it all. And we who, being on the outside, have only a small opportunity to judge must go on wondering how much credit to give to each of the many systems, all advocated by men who are as honest as they are enthusiastic, that are presented to our attention as being the *ne plus ultra* of cost cutting.

And now comes John Randol, and hits Osborne pretty hard when he accuses him of gross blunders in shop management, because he has not adopted the "written orders only" system. Say, Mr. Editor, that hit me hard. I have long been a stickler for just that sort of thing, but I want to tell you that I sometimes feel as though I really didn't know it all; at any rate not quite all, for didn't I have a tough experience once in that very line when I was foreman of a little one-horse shop where we built some pretty expensive machinery that wasn't exactly interchangeable, as I now understand the term.

Billy Worden wasn't such a bad lathe hand, and he used to do pretty well, sometimes working from a blueprint, mostly from verbal orders, and occasionally from a freehand sketch. One day he was working from one of the latter, and what do you suppose he did? He cut off twelve brass piston rods 1 inch in diameter and 12½ inches over all, when the sketch plainly showed that the 12½ inches should have been from a shoulder near the other end, which was the crucial measure of the piece, as had been carefully explained to him before he began. The worst of it was that he had previously roughed the rods to over-all length from the bar, and had to cut about 3 inches off of each in the spoiling operation.

That gave me a jog that I haven't forgotten yet. Here was a man who had done lots of good work from verbal orders, falling down good and hard on a perfectly clear sketch, supplemented with the usual explanations, which were designed to insure his understanding thoroughly what was expected of him.

And now the question arises, "Is any system, however well thought out, an absolute safeguard against error?" Sadly, shamefacedly, we are compelled to admit: "Not so long as it has to be carried out by mere human beings who, though descended from a prototype who was created in the image of the Almighty, are yet prone to error."

And still, Mr. Editor, no one could convince me that system isn't a good thing, and I mean to try to build up a pretty satisfactory edifice out of bricks taken from various systems, cemented by such judgment as I may possess after an experience which has taken about all of the conceit out of me. L. O. DANSE.

Detroit, Mich.

The Abolition of Smoke.

Editor American Machinist:

Please take particular notice of the word abolition. The strike of the anthracite coal miners is a beautiful illustration of how a cause produces more than one effect, as Herbert Spencer says it always does. In this case the incidental or secondary effect would seem to be bigger than the direct effect. Many, especially in New York city, who have only a very vague interest in the matters in controversy between the miners and the operators are provoked to active and constant thinking and talking about smoke by the recent intrusion of its unwelcome presence.

To me one of the silly and profitless

things of the time is the talk about smoke consumption and the burning of soft coal without smoke. I am convinced that there is only one way to burn soft coal continuously without smoke, and that is to burn it somewhere else, far away where you don't see it. I know they will show us in the laboratory how, after numerous experiments and adjustments, coal may be burned without smoke, and some fellow with a newly invented stoker or a furnace or a grate, or something of the sort, will occasionally give an exhibition to demonstrate that where there is fire there must not necessarily be smoke; but coal, after all, is burned by the average user not to generate smokelessness, but to generate steam, or at least heat, and in the eagerness to get the heat the smokelessness is pretty sure to be forgotten. It may be pretty well proved that coal may be burned without smoke, but it is much more surely proved that coal is not and will not be so burned.

If we can't stop the making of smoke we can stop the burning of coal in cities, and that is the thing to steer for. Right here is where I come in as an abolitionist, and, like some other abolitionists we read of, I may be a little, but only a little, ahead of my time. I am for the abolition of smoke. I believe not only that smokelessness in cities is possible, but that it will be before long the thing to be insisted on, secured and maintained as one of the conditions of civilized life.

I know an ocean steamer can't get its coal burned on shore—not yet—and even a locomotive is still dependent on the fuel it carries with it, and to the former I concede without debate, and to the latter temporarily, the right to make what smoke is practically unavoidable, but I do not concede to any city, or to anyone in it, the necessity or the right to make smoke. It is amply possible for any city to do everything that is done in it or for it, if not without producing smoke at least without producing the smoke where its citizens are unpleasantly cognizant of it. All that we as communities now do for ourselves with the accompaniment of the smoke nuisance science and practical engineering have put easily within our reach the ability to do with clear skies and breathable air. The thing, being demonstrably possible, is the thing to be insisted upon; it is the thing which undoubtedly the future will see, and it is well worth keeping in sight and working for.

Sometimes I do get completely discouraged, and I am not alone in it. There are possibilities that I see so clearly and surely of better conditions that must eventually prevail which yet come along so slowly, if, indeed, they are moving at all toward their accomplishment. One of these is this entire non-necessity of coal smoke in any city. The ability to get or not to get anthracite has nothing at all to do with it. For power in all its applications and for light for every purpose we have the electric current, which, if backed by steam and that backed by soft coal, may be generated miles away, where, when smoke is made, it will not be belched down upon the inhabitants. For heat and the other purposes for which fuel must still be used we have coke, gas, oil and anthracite as long as it lasts. To assume that smokelessness must be a departing luxury to soon go out with anthracite is absurd. It is instead a coming luxury, not for New York and a few favored spots in the East, but for every town and for all the people. As I said, I do at times feel discouraged to see it coming along so slowly, but the trouble is that the people do not know, and it is good to keep telling them, as I try to do, what is their right and their privilege that they may get up and insist upon it. Pure air is just as necessary as pure water. We try to insist upon pure water and do not allow contamination of it when we know it, and it is outrageous that wholesale and continuous defiling of the atmosphere should go on without protest as a thing which must be endured whether or no. There is now no more excuse for filling the air with smoke than for filling a stream constituting the water supply of a city with the drainage of a slaughter-house.

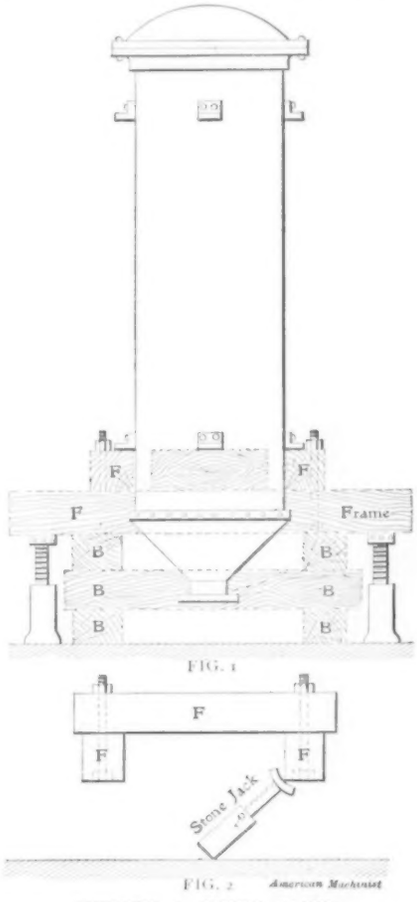
For one thing, it will never come by any half-way measures. Smokelessness is a thing where it exists which is in the nature of things absolute and incontrovertible, and that is the thing to begin to insist upon. We either have it or we have it not. To make ordinances prohibiting the production of *dense* smoke, as some of the Western cities do, is to give away the whole thing. The gage for smoke density will always be according to the interest or influence of the individual, but about complete smokelessness, such as has been familiar to the citizens of New York, there can never be any question. That is the thing to be insisted upon. Smoke is not to be mitigated or minimized, but to be abolished. If anyone pollutes the atmosphere put him at once on the defensive and let him not escape by excuses or explanations but by stopping the evil practice.

It is really in the direction of economy that I am pointing, as well as toward health and cleanliness. Smokelessness has made progress. We do vastly more than we were wont to do without a commensurate increase of smoke. Electricity has given us an enormous stride toward emancipation. Take all that electricity has done and is doing for modern life and consider what a smoke we would have if it had to be all done by the methods in vogue before electricity came in. The elevated railroad in New York at the present writing is giving a most impressive object lesson in smoke and smokelessness. On the east side of the city two of its lines are operated by electric motors, and on the west side the other two lines are operated by locomotives burning soft coal. On the one side we have smokelessness with economy and on the other side we have smoke and its detestable accompaniments at a considerably greater cost for the work done. All the work that all the coal in the city or in any city does can be cheapened eventually by smokeless methods, or at least by methods which will not make smoke within cities or thickly populated districts. The wires, gas pipes, water pipes and air pipes may combine to do this, but the wire will probably be the principal agent. TECUMSEH SWIFT.

Turning a Heavy Tank.

Editor American Machinist:

I send a sketch showing how a tank 37½ feet high, 8 feet diameter, weight about 20 tons, was turned half around. The tank rested on a frame *F* made of 12x12-inch timber. *B* is blocking under the frame. A jackscrew was put under each corner of the frame and when all was ready the man in charge gave orders to turn the screws, which was done by a man at each screw. The frame *F* was lifted off the



TURNING A HEAVY TANK.

blocking about ¼ inch. A stone jack was put against a corner, as shown in Fig. 2, and the tank was turned about 2 inches, when the jackscrews were lowered until the frame rested again on the blocking. This operation was repeated until the tank was in the required position, all being done in 1 hour and 45 minutes. SAILER.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,000 copies are printed. Total for 1902, so far, 480,250 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
Test of an Otto Gasoline Engine	897
A "Follow-Die" which Draws, Pierces, End-Finishes, Cuts Off and Bends in One Operation	900
Echoes from the Oil Country	900
Hardening Thin Cutters	902
Trade Matters in Tangiers, Morocco, and in Gibraltar	903
A Shop Accident Emergency Outfit	904
Hollow Forgings	904
A Ready Construction of the Ellipse	905
The Premium Plan at the Blank Blank Engineering Works	906
From a Designer's Note Book	909
A New Compound for Welding Steel	911
Letters from Practical Men: A Chilling Plate Press....Local Case-Hardening....Die Holder....A Volcanic Suggestion from the Foundry....Molding Spiral Gears and Worms—Breaches of Confidence....Systems and Opinions....The Abolition of Smoke....Turning a Heavy Tank	911-915
The Non-Necessity of Smoke	916
The Engineer Captain	916
The American Section of the International Association for Testing Materials Secedes	916
A Window Glass Making Machine	917
The Situation in Worcester	917
Some New Things	917
Personal	917
Commercial Review	918

The Non-necessity of Smoke.

In this issue Mr. Tecumseh Swift has something to say about the abolition of smoke. He is undoubtedly right in his assumption that pure air is as necessary to satisfactory life as pure water; that one has no more right to pollute the one than the other; that, thanks to the developments of modern science and engineering, it is perfectly possible to so arrange our operations that all the functions of city life may be fully operative without smoke, even though soft soal is the chief source of heat and power. It is possible, for instance, for Chicago and St. Louis to be as smokeless as New York has been heretofore. This ideal smokelessness is not attainable if soft coal is permitted to be used generally throughout a city, no matter what arrangements may be adopted and ordinances enacted for its "smokeless" combustion. Thanks chiefly to electricity, the coal may be burned so far away that its combustion need not even be known of in the city, except by the power and light transmitted. This is the possibility which it will be well to bear in mind and to unitedly work for. It is not necessary to be too enthusiastic as to the immediate accomplishment of what is so clearly possible and so intensely desirable. In merely talking up the matter we are distinctly facing in the right direction and more or less provoking to aggressive action. There may be a determined stepping forward before long, and no better rivalry could arise between our cities than in this matter of smokelessness. The proposition of smoke abolishment is, after all, only in a larger way suggesting the separation of the workshop, the stable, the kitchen from the living and sleeping places. Whatever our activities and necessities, it is not necessary to litter the entire establishment with the refuse, whether it be a mansion or a city.

The Engineer Captain.

The *Marine Journal* seems not to understand that the "line and staff fight" in the navy has been settled by their amalgamation and that hereafter there is to be no recognized way of distinguishing between an engineer officer and any other. It delivers itself thus:

"Imagine the captain of an ocean steamship being lost overboard from the bridge and the engineer coming on deck and assuming charge, and you have a practical illustration of what might be the result as to the future discipline of the ship the rest of that particular voyage. This action of the Secretary of the Navy is another argument against a civilian having any voice in the practical management of naval vessels, any more than landsmen have to do with the navigation of merchantmen."

If our esteemed contemporary will look the matter up, it will discover that owing to the senseless opposition of the "line clique" to allowing the engineer officers in the navy any authority or privileges at all distinctions between line and staff have been wiped out and that now a captain is supposed to be also an engineer and *per contra* an engineer is supposed to be any other executive officer to which his rank entitles him. Comparisons with the merchant marine are entirely beside the mark. Engineers of merchant vessels have always, or at least generally, been conceded authority over their departments and all the men employed in them. Engineers in the navy asked for the same and instead were given actual instead of "relative" rank, which makes them as good as any other officer on board ship and prevents their being subjected to indignities at the pleasure of stripling graduates of Annapolis. If it carries with it some absurdities, that fact is to be charged to the government's way of doing things, which differs generally from the way similar things are done by private individuals or companies.

The American Section of the International Association for Testing Materials Secedes.

At the Atlantic City meeting of the American Section of the International Association for Testing Materials, held on the 13th inst., that body seceded from the International Association and formed a society to be known as the American Society for Testing Materials. Members of the American society must, however, be also members of the International one. This rule is a little difficult to understand in view of the known fact that differences had arisen between the American section and the European sections which were finally found to be irreconcilable, the charge being made that the majority of the members of the American section were apparently not well informed regarding the latest and highest developments in the science of testing as were too much influenced by purely commercial considerations, and could not therefore be induced to agree to a system of testing which should be uniform throughout the world and at the same time strictly scientific and correct. Whether or not this be true, we do not pretend to say or to know, but the fact that differences of that nature had arisen makes it seem strange that any attempt at quasi-affiliation should have been attempted. So long as a break was considered inevitable it would have seemed more logical to have made a complete one and to have admitted to membership in the American society anyone considered to be competent and qualified whether a member of the International society or not.

At the same time, and independently of the causes that may or may not have led to the secession it must be regretted that such a step was considered necessary. All things which tend to bring engineers throughout the world into closer relations with each other are to be commended as tending toward a better understanding between nations and a better foundation for the international trade that is the great

civilizer and enlightener of peoples. In our growing foreign trade there would be manifest advantage in having American-made materials accepted abroad upon the basis of precisely the same tests they are subjected to and accepted upon here, and it would seem to be obvious that the fact that American materials may be or are to be generally made to specifications based upon methods of testing considered inadequate and erroneous by the highest authorities on testing abroad will work to the prejudice of American producers of such materials and of structures composed of them. The movement for an international agreement and for a uniform system of testing structural materials was distinctly an important step in the right direction and it is much to be regretted that it has miscarried.

A Window Glass Making Machine.

A machine has recently been introduced by the American Window Glass Company, at Alexandria, Ind., which it is believed will do away with a very large number of employees, and it is announced that the machines will be generally introduced. The window-glass business is controlled by a trust, and it is therefore unlikely that the general public will derive any immediate benefit from the use of this machine. Its only effect, as things now stand, will be to throw a lot of men out of employment and to throw a lot more money into the coffers of the window-glass trust, though of course if there were competition among window-glass makers, all of whom were able to buy the machine, then the results of the introduction of the machine would be a lowering of the price of window glass by the operation of the ordinary commercial laws.

Coincident with the announcement that the new machine for making window glass is believed to be an assured success, that it will probably stop the importation of window glass and enable American window glass to be sent abroad, comes the news that prices of window glass have been advanced 5 per cent. by the trust. This is not the usual way of stopping importations, and one is impelled to wonder how it is going to work.

The Situation in Worcester.

The status of the Worcester machinists' strike remains practically the same as last week. The report has been current that the Prentice Bros. Co. were making overtures for a conference with a committee from the labor union. This, the said company has emphatically denied in an article printed on the 19th inst. The labor union held its regular meeting on Friday morning, but little business aside from the formal roll call was transacted.

Some of the strikers are making an effort to secure work in local shops outside the strike radius and four of Prentice Bros.' men had secured what looked like good jobs in another large shop, but their record having been looked up they were asked to move on.

The little excitement over the strike noticeable a month ago seems to have died out and a casual observer would not notice anything unusual even in the vicinity of the proscribed shops. O.

Worcester, June 21.

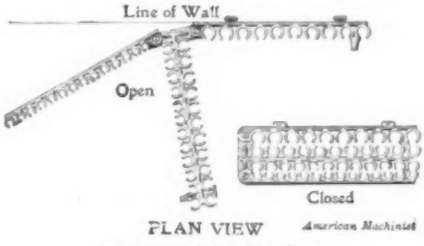
A strike having some very odd features is reported from Manchester, Ind., where, according to a press report, sixty employees of the Syracuse Manufacturing Company struck because the manager of the business who owned one-quarter of it wanted more than $1,000 a year salary and his partners had refused to grant the increase to $1,500 which he asked for. The outcome of the strike is not announced, but it will be interesting to know the result and in the meantime we may remark that a manager of a manufacturing business large enough to employ sixty men who is not worth more than $1,000 per year is worth nothing at all. Whether the strike wins or loses there will be one establishment in which the manager will find it difficult to say that the men have no right to strike, but the owners of the other three-quarters of the business may differ from him on that point.

A general advance of 10 per cent. in wages was announced at the Joliet mills of the Illinois Steel Company on the 18th inst. Machinists employed there who had been receiving 29½ cents per hour were advanced to 32 and 33 cents.

Some New Things.

FILE AND TOOL HOLDER.

This file and tool holder speaks for itself and needs no explanation. It is shown both open and closed in the cut. It is

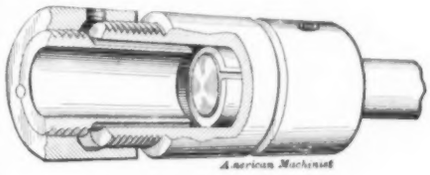


FILE AND TOOL HOLDER.

fastened to the wall, holds forty-seven files, and when closed occupies a space of 15x6 inches. George W. Bowers, of Waltham, Mass., is the maker.

COMPRESSION COUPLING.

A new compression coupling has been brought out by the Vandergrift Coupling Company, of Indianapolis, Ind. The body of the coupling is a sleeve with a fine pitch right-hand thread cut on each end. The inside of the sleeve is tapered from the center out to the ends. Two split bushings, bored for the shaft and provided with left-hand threads, are turned to fit the taper in the sleeve. By means of the nuts, which are provided with pin holes for a spanner wrench, the bushings are drawn into the sleeve and grip the shaft. This coupling will tighten itself when running in either direction. When running in one direction the bushings turning in the nuts force themselves into the sleeve; when running the other way, by means of interlocks the nuts are



COMPRESSION COUPLING.

coupled to the bushings, and when the latter turn the nuts turn with them and draw them tight into place. This coupling has no projections to endanger workmen and is easily kept clean.

A new article which is of interest to shop men is known as "Glasbrite." It is manufactured in Cleveland, Ohio, by Clark & James, 122 Water street, and is guaranteed to clean the dirtiest shop windows by merely being applied with a damp cloth or sponge. It also cleans metals of all kinds.

Personal.

Samuel M. Nicholson, president and general manager of the Nicholson File Company, Providence, R. I., has been chosen president of the American Screw Company.

James Rowland Bibbins has resigned as assistant electrical engineer of the Detroit United Railway to accept a position in the Westinghouse Companies' Publishing Department, Pittsburgh and New York.

Fred H. Colvin, for the past five years vice-president of the Angus Sinclair Company and associate editor of *Railway and Locomotive Engineering*, has severed that connection, but has not yet announced his new line of work.

George Rowbottom, who for the past twelve years has been connected with the Waterbury Farrel Foundry & Machine Company, is president of the newly formed Rowbottom Machine Company, Waterbury, Conn., which will build sheet metal working and special machinery.

John Campbell, well known in railroad mechanical circles and for some time with the Dickson Locomotive Works at Scranton, has opened a jobbing and repairing machine shop at 300 East Sixty-fourth street, New York, where he will design and build special machinery and make repairs to automobiles or anything else that is a machine.

George Paroschol, of Athens, Greece, who was graduated in June from the Massachusetts Institute of Technology, has enrolled in the American School of Correspondence of Boston. Mr. Paros-

chol expects to complete the School's course in the fall, when he will return to Greece to accept an engineering position under the government.

Commercial Review.

NEW YORK, Monday, June 23.

MACHINE TOOLS AND MISCELLANEOUS.

The action of a numerous assemblage of American lathe builders in agreeing to advance prices, which was reported in this paper last week, is naturally a subject of interest in the machine-tool trade. There is a little tendency to think that it has taken place somewhat late in the day, for a feeling exists that the hight of the boom is past. The large shops in this vicinity, it is remarked, have supplied their chief necessities in equipping for work, which is not to deny, however, that new ones may be starting in. One representative, and characteristically optimistic, machine-tool dealer in town notices a perceptible quieting in new orders, although, as far as shipments are concerned, he broke his record last month and is sending off a good deal of stuff this month, too.

A pretty striking example of the heavy demand for machine tools which has been prevailing of late, and which is not yet over, is found in the case of a planer building concern which has been waiting two or three years unable to fill some orders placed with itself for its own equipment. The company has chosen to supply its customers before filling its own wants, though one would suppose that its provision for the latter might be best served by attending to itself first.

Jas. Clark, Jr., of Jas. Clark, Jr., & Co., Louisville, Ky., was in town last week. His firm is a builder of a line of upright drills and other machine tools for which it finds its principal market in the North, and also of dynamos and motors which it sells largely in the South. It has, however, been furnishing a good deal of machinery to the United States Government. A shipment has lately been made to the Philippine Islands. Mr. Clark says that his concern has been getting all the business it could conveniently handle. It has escaped labor troubles this year, having passed through its difficulties of that sort last year.

One of the most important pieces of news is that the International Steam Pump Company, whose new plant near Newark, N. J., has already been pretty loudly heralded, is now taking estimates on machine tools. Some pretty large ones are among them. The requisitions call for figures on tools both motor driven and otherwise. Without attempting to be exact, the valuation for the outfit now called for is estimated as running up to $100,000.

It is said that the J. L. Mott Iron Works, New York, will probably break ground in Trenton, N. J., about the middle of July for a plant to cost upwards of $1,000,000 and employ 2,250 men.

The Utica Industrial Company, Rome, N. Y., is in the market for machine tools and small tools and supplies for a machine shop which it is fitting up for the manufacture of special automatic machinery.

The C & C Electric Company is installing additional tools in its works at Garwood, N. J. They include lathes, milling machines, punch presses, grinders, planer, etc.—about fifteen tools in all. The company has booked more business since January 1 than in any such period previously, has more orders on file than ever before and is running its shop at night.

The McCaffrey File Company, Philadelphia, is said to be shipping large parcels of files to Germany and South America.

Bids will be opened by the Bureau of Supplies and Accounts, Navy Department, Washington, June 28, for a revolving crane for the navy yard at Norfolk, Va.

The report of the American Screw Company for the year 1901 shows profits of only $152,109, as compared with $413,956 for 1900. After deduction of a 5 per cent. dividend there is $10,090 deficit. The president, however, makes a statement explaining this on the ground of aggressive competition forcing down prices to very low levels, and of extraordinary expenditures. He says that the volume of the company's products and sales has been greatly enlarged. He also makes the following interesting prediction: "During the current year we anticipate that selling prices may decline still further, until none but the best equipped screw plants can handle the business. Under such conditions your best interests require that dividends should not be paid unless fully earned."

The property of the Eddy Electric Company, of Windsor, Conn., was sold at auction, June 21, by order of the Superior Court, the successful bidder being Hindell Parson, of New York. The price paid was $35,000.

It is possible that the germ of a matter which will hereafter develop importance in the electrical machinery trade is contained in the following from Trenton, N. J.: "The American Union Electric Company has filed papers increasing its capital stock from $100,000 to $7,000,000. The papers were signed by Howard Marshall, president, and John J. Cuneen, secretary. The company was incorporated June 10 to manufacture electric dynamos."

The engineering department of the Pittsburgh Gage & Supply Company, Pittsburgh, Pa., has secured through Victor Beutner, engineer, Westinghouse Building, Pittsburgh, an order for one pair 600 horsepower Brown Corliss Engine Company (Corliss, Wis.) twin engines to drive direct connected electric generators at 136 revolutions per minute in the new mill of the Susquehanna Iron & Steel Company, Lancaster, Pa. Another notable order was from the Hooven, Owens & Rentschler Company, Hamilton, Ohio, for supplying two cross-compound engines of their manufacture with a White Star Filtering System. These engines are destined for the power plant of the Cincinnati, Georgetown & Portsmouth Railway Company.

Contracts have already been placed by the William Tod Company, Youngstown, Ohio, builder of engines, etc., for the buildings and a part of the machinery to constitute a material enlargement of the company's plant. Among the additions made will be a new erecting shop 70 feet crane span and 70 feet high by 200 feet long, provided with two 50-ton cranes, with 10-ton auxiliary hoist; an additional machine shop 50 feet span, 50 feet high by 200 feet long, which will also be equipped with proper crane capacity; a forge shop 30 by 150 feet, and a new boiler plant. They are purchasing sufficient large and small tools practically to double their present capacity.

The Riter-Conley Manufacturing Company, of Pittsburgh, Pa., has decided to adopt alternating-current motors exclusively for power distribution, including the operation of cranes. It has purchased three 200-kilowatt engine-type Westinghouse generators which are to be direct connected to Westinghouse gas engines using natural gas. A number of Westinghouse type "F" induction motors will be geared directly to straightening rolls. The Steubenville (O.) & Wheeling (W. Va.) Traction Company has just purchased two 500-kilowatt Westinghouse railway generators. The Hudson Valley Railway Company, a consolidated company operating over 100 miles of road running north from Albany and Troy to Saratoga, Lake George and the Adirondacks, intends to derive current from the new Hudson River Power Station near Waterford, N. Y. For addition to the equipment of the system previous to the completion of that plant, the Westinghouse Company has installed in some cases—and in others is yet to install—about half a dozen machines of 250 and 270 kilowatts in size, generators and rotary converters, besides transformers. We learn also from the Westinghouse people that the permanent equipment of the sub-stations for use after the power plant is finished next year will be of their make.

MR. KATES ON CUBAN AFFAIRS.

We have at different times in the past quoted the opinions on trade with Spanish-American countries, given by Mr. Norbert B. Kates, of the export firm Kates & Bok, of this city. Mr. Kates has just returned from a flying visit to Cuba. He found current business making a considerably worse showing than even the poor one which had ruled since the war, while the general outlook has suffered enormous detriment, as a result of the failure of even a 20-per-cent apology for a reciprocity treaty. The lack of a settlement of the tariff as needed by the island not only causes a general depression through the damage to the sugar market, but it delays the placing of orders abroad

because of the entailed uncertainty as to what the import duties are to be hereafter. There is next to nothing going on in mechanical improvements on the island. In short, the situation is better described by what it is not than by what it is.

The size of the sugar crop that has been produced in Cuba in spite of the devastation caused by the war, is highly creditable to the planters. The greater part of the available capital of the island has gone into that industry. The credit of banking houses and planters has been exhausted awaiting the action of the United States. Anticipating a reduction of the duties, the sugar resulting from the crops has been hoarded at the principal shipping points. At the present time it is estimated that 1,000,000 bags each are warehoused in Matanzas and Cardenas. How much of this is held by the planters on their own account and how much by the Sugar Trust is not easy to determine.

The business people of Cuba, on their part, are maintaining as calm and collected a demeanor as they very well can under the circumstances. They will probably continue to make further efforts in the sugar industry, even under the discouragements that have attended their pains. Especially the plantations near the points of shipment are able to produce sugar if need be at a considerable sacrifice from normal profits. A sugar field will stand twelve or fourteen cuttings, so that in many instances it is only a question of clearing the fields. The attitude of the planters resembles that of manufacturers in this country who make every effort to keep their plants going during hard times. Some hope is entertained that the European sugar bounties will be removed, thus opening for Cuba other markets.

As reasonable a view as possible is taken of the policy of the United States. The people are still grateful to us for what they have to be grateful for, and while they regard the refusal of reciprocity as a dishonorable repudiation of an obligation, they appreciate the fact that our administration has tried to secure the needed legislation. The underlying cause of the failure of the bill they are at a loss to explain.

The new Cuban Government is composed of sound men, and it has the confidence of the people, including the Spanish residents, who participated noticeably in the public display of approval at the time of the inauguration.

To sum up, Cuba has been fearfully damaged in its business, while at the same time it has not so lost ambition as to disintegrate or go back to a wilderness without further effort.

Mr. Kates did not visit Porto Rico, but he believes that conditions there are considerably more favorable, it being remembered that that island has free trade with the mainland. None of the Spanish-American countries is enjoying a boom.

Mr. Kates will start about the middle of next month for a six or eight months' trip, during which he will tour in South America.

EGYPT'S MACHINERY IMPORTS.

According to a special communication which has come to us from Simon W. Hanauer, U. S. Deputy Consul-General, Frankfort-on-the-Main, Germany, Egypt's importation of machinery in 1901 amounted to 533,000 Egyptian pounds (an E. £ = $4.94 U. S. money). The following were some of the leading machinery items: Locomobiles, 102 in number, of which came from Great Britain, 95; Germany, 2; Belgium, 1; Italy, 4. Locomotives, 56, of which came from Great Britain, 22; Germany, 9; Belgium, 14; United States, 11. Other machines propelled by steam, 143, of which came from Great Britain, 117; Germany, 8; Italy, 3; France, 5; Switzerland, 4. Steam boilers an ' parts of engines, etc., total value E£127,520, of which came from Great Britain, E£76,772; Germany, E£8,045; Belgium, E£16,322; Italy, E£8,519; France, E£9,848; Switzerland, E£7,005. Pumps, total value E£20,158, of which came from Great Britain, E£11,090; Germany, E£1,025; United States, E£1 421; France, E£4,899. Other machines, total value E£187,899, of which came from Great Britain, E£123,094; Germany, E£23,005; Belgium, E£14,266; Italy, E£3,680; France, E£17,598; United States, E£1,069; Austria, E£3,244.

CHICAGO MACHINERY MARKET.

The threatened strike of the bituminous coal miners seems to have cast a temporary spell over new business in machinery in the West, including among other lines electrical equipment. This has been a feature of only a few days. There has been, and there continues to be, a great storage of fuel in anticipation of that contingency, especially among the larger users. It is usually the first shock that is the most noticeable, and if this proves true this time conditions will improve, whatever may be the outcome of the pending strike. With a heavy stock of coal to begin upon, with the season the warmest of the year and with a fairly good field of non-union mined coal to draw upon, the fuel situation is not so hopeless as appears at first sight, even if the men do go out July 17.

And comparing the current trade in electrical machinery by months, there cannot be perceived any deterioration. Thus one Western maker of this kind of machinery is said to have booked within the past month enough business to keep his factories busy for four months. Small-sized motors and generators he can deliver in about three months, but some large units have just been sold for shipments twelve months hence. The business is going into all branches of use. Street railway equipments, municipal work, factory installations are all called for in undiminishing quantities. One of the large contracts taken recently is the electrical equipment of new shops to be erected by the Pittsburgh & Lake Erie Railroad. In this work the multiple voltage system of special control will be employed. The Crocker-Wheeler Company secured the contract. Other orders recently booked by the Crocker-Wheeler Company include the following: A 300-kilowatt generator, engine type, by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio; a 90-kilowatt generator, belted, and motors aggregating 130 horse-power, by the Moline Malleable Iron Company, St. Charles, Ill.; a 50-kilowatt generator, engine type, by the Kirby Manufacturing Company, Cleveland, Ohio, for installation at Loveland, Colo.; twenty-four motors by the Gunthorp & Warren Printing Company, Chicago; a 90 belted generator by the Minot Light & Telephone Company, Minot, N. D.; etc.

The Bullock Electric Manufacturing Company has just sold a 600-kilowatt direct-connected generator to the Denver Gas & Electric Company, supplementing two 600 and one 1,500 kilowatt generators previously sold; also two 400-kilowatt direct connected generators to the St. Paul Gas Light Company; also three 1,000-kilowatt generators and four sets of motors of 600 kilowatts each to the New Orleans & Southwestern Railway. The company has also sold five motors for shop equipments to the Hill Clutch Company, Cleveland, Ohio, and eleven motors to the Bradley Manufacturing Company, Pittsburgh. Another large Pittsburgh order consisted of four 2,200-kilowatt generators to the Pittsburgh Reduction Company, Pittsburgh.

Quotations.

NEW YORK, Monday, June 23.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$21 15	@ .....
No. 2 X	20 65	@ .....
No. 2 plain	20 15	@ .....
Gray forge	19 65	@ .....

Alabama Pig, New York delivery:

No. 1 foundry, or soft	20 75	@ .....
No. 2 foundry, or soft	20 25	@ .....
No. 3 foundry	19 75	@ .....
Foundry forge, or No. 4	18 75	@ .....

The maximum prices of pig iron are indefinitely high.

Bar Iron—Base sizes—Ordinary refined brands, mill price on dock, 1.93 @ 2.10c. in carload lots. Smaller quantities from store, 2.15c. upward.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 28½ @ 28¾c.

Pig Lead—4.10 @ 4⅛c., in 50-ton lots.

Spelter—New York delivery, 4⅞ @ 5¼c.

Antimony—Cookson's, 10½c.; Hallett's and U. S., 8⅛c.; various brands, 7¾c.

Lard Oil—Prime City, 78 @ 83c. in wholesale quantities.

New Catalogs.

Schumacher & Boye, Cincinnati, Ohio. Engine lathes. 6x9, pp. 35, paper.

Crocker-Wheeler Company, Ampere, N. J. Small power motors. 6½x3½, pp. 20, paper.

C. W. Hunt Company, New York. "Examples of Economic Coal Handling." Pamphlet.

Canadian General Electric Co., Toronto, Ont. Wires and cables. 5¼x7¾, pp. 36, paper.

Westfield Factory, Westfield, Mass. Facilities for doing work of outside concerns. Folder.

Dreses Machine Tool Company, Cincinnati, Ohio. Screw and turret machinery. 6x9, pp. 36, paper.

F. F. Slocumb & Co., Wilmington, Del. "Caskey" portable pneumatic punch. 6x9, pp. 16, paper.

Franklin Portable Crane & Hoist Company, Franklin, Pa. Cranes and hoists. 4x7, pp. 16, paper.

Jeffrey Manufacturing Company, Columbus, Ohio. Screens and screening machinery, 6x9, pp. 48, paper.

Ames Plow Company, Boston, Mass. Farming implements, barrows and trucks. 6x9, pp. 84, paper.

Christensen Engineering Company, Milwaukee, Wis. Motor-driven air compressors. 6x9, pp. 20, paper.

Electric Controller & Supply Company, Cleveland, Ohio. Electric controllers. 6x9, pp. 22, paper.

Cincinnati Machine Tool Company, Cincinnati, Ohio. Upright drilling machines. 6x9, pp. 35, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Parts of "Wood" arc dynamos. 4½x6½, pp. 84, paper.

Canadian General Electric Company, Toronto, Ont. "Inner Globes for Enclosed Arc Lamps." Pamphlet.

Osborn Manufacturing Company, Cleveland, Ohio. Foundry supplies, brushes and brooms. 5x7½, pp. 96, paper.

The Bristol Company, Waterbury, Conn. Recording volt, ampere and watt meters. 9¼x12, pp. 28, paper.

J. M. Carpenter Tap & Die Company, Pawtucket, R. I. Tools for cutting screw threads. 6x3½, pp. 118, paper.

Cleveland (Ohio) Punch & Shear Works Company. Plate metal working machinery. 7¾x5¼, pp. 118, cloth.

The S. Obermayer Company, Cincinnati, Ohio. Treatise on foundry facings and blackings. 3½x6, pp. 14, paper.

Garvin Machine Company, Spring and Varick streets, New York. Plain milling machines. 6x9, pp. 20, paper.

Crane Company, Chicago, Ill. Steam fittings for ordinary pressures, and general catalog. 10½x7, pp. 362, cloth.

Columbia Factory, 446 Capitol avenue, Hartford, Conn. Facilities for handling work for outside concerns. Folder.

A. H. Nilson Machine Company, Bridgeport, Conn. "Automatic Wire Straightening and Cutting Machine," circular.

Peerless Rubber Manufacturing Company, 16 Warren street, New York. Packing and engineers' specialties. 6x3¼, pp. 40, paper.

Brown & Sharpe Manufacturing Company, Providence, R. I. Latest additions to their lists of machinists' tools. 3½x6, pp. 20, paper.

American Steel & Wire Company, spring factories at Worcester, Mass.; Waukegan, Ill.; San Francisco, Cal. Springs. 7¾x5¼, pp. 78, paper.

Niles-Bement-Pond Company, New York. Machine tool booklet, for distribution at Crystal Palace Exposition, England. 3½x6, pp. 23, paper.

Pawling & Harnischfeger, Milwaukee, Wis. Special bulletin of chain block traveling cranes and standard I-beam trolleys. 7½x11, pp. 12, paper.

Schwencke, Kirk & Co., New York, and Hoboken, N. J. General catalog of drafting-room supplies, mathematical instruments, etc. 6x9, pp. 160, paper.

Garvin Machine Company, Spring and Varick streets, New York. Catalog No. 7 of cutter, reamer and surface grinding machines, 6x9, pp. 24, paper.

Studebaker Bros. Manufacturing Company, South Bend, Ind. Wagons for military operations. 7x10, pp. 25, paper. Souvenir booklet of Studebaker factories. 5¾x6¼.

New Corporations.

Manhattan Tool Co., of New York; capital, $100,000.

The Jordan Manufacturing Co., Tacoma, Wash.; capital, $200,000; object, to establish a plant for the manufacture of locks, bolts, etc.

Deming-Berry Company, Seattle, Wash. (capital, $300,000), by J. W. Berry, J. G. Deming, E. A. Spaulding, *et al.*, to erect a foundry.

Dunn Petroleum Burner Co., San Francisco, Cal.; capital stock, $500,000. Incorporators: E. W. Dunn, Hugh Craig, J. A. Margo, J. F. Merrill, J. G. Grannis, *et al.*

Electric Self-winding Clock Co.; principal office, 12 Hudson street, Hoboken, N. J.; capital, $200,000. Incorporators: Louis Steckler, Benjamin Crafer, William A. Mailliet.

Calkins Co., Los Angeles, Cal.; object, manufacturing mining supplies; capital, $100,000. Incorporators: H. C. Norris, A. C. Calkins, A. J. Morse, *et al*, of Los Angeles, Cal.

The International Telewriting Co., of St. Anthony, Idaho; object, manufacturing electrical machinery; capital, $600,000. Incorporators: F. V. Gomers, C. E. Bowerman, C. C. Moore, *et al.*

Ray Automatic Machine Co., Augusta, Me.; object, making and selling machinery and tools of all kinds; capital, $200,000. President, F. L. Dutton; treasurer, E. F. Whittum, both of Augusta, Me.

Bingham & Co.; principal office, 419 Market street, Camden, N. J.; object, manufacturing iron, etc.; capital, $100,000. Incorporators: Robert Bingham, Thos. G. Newbery and Samuel W. Anness.

Newman Manufacturing Co.; principal office, Third and Port avenues, Elizabeth, N. J.; object, manufacturing steam specialties; capital, $5,000. Incorporators: J. W. Newman, Chas. Brown and Geo. W. Orthey.

New Steel & Iron Co.; principal office, North End of Fifth street, Camden, N. J.; object, manufacturing iron, steel, etc.; capital, $100,000. Incorporators: John B. Wood, Horatio C. Wood and Arthur M. Wood.

National Computing Scale Co.; principal office, The Corporation Trust Co., 15 Exchange place, Jersey City, N. J.; capital, $650,000. Incorporators: H. O. Coughlan, Louis B. Dailey, Aug. S. Meeker, K. K. McLaren and others.

The Union Foundry & Machine Company, Salt Lake City, Utah, with capital stock $15,000, by L. C. Sinclair, president; F. F. Betts, secretary, *et al.* The company's present place of business is at Fourth West and Seventh South streets.

New Process Metal Rolling Machine Co.; principal office, 332 Harrison avenue, Harrison, N. J.; capital, $125,000. Incorporators: Warren C. Clouse, Wm. L. Jones, Neil Andrews, Harry L. Bennett, James L. Terhune, May Crane and John D. Crane.

Articles have been filed for the incorporation of a wood-working factory at Monroe, Wash., with a capital stock of $100,000. The incorporators are Edwin M. Stephens, D. F. Stephens, Lewis L. Stephens and B. F. Bird. The style of the firm is Stephens Brothers. We understand that their shingle mill is already in existence.

Ohio Brass Co.; principal office, Corporation Trust Co., 15 Exchange place, Jersey City, N. J.; object, manufacturing railway supplies, etc.; capital, $1,000,000. Incorporators: Frank B. Black, Reid Carpenter, Charles B. King, Harry S. Black, George S. Lucas and E. T. Cooke.

Manufacturers.

A machine shop and car works is projected at Beaumont, Tex.

The Nineteen Hundred Washer Company, Binghamton, N. Y., will double its factory.

J. A. Jamison and G. D. Snyder will build a planing mill at Santa Monica, Cal.

H. G. Richardson, of Olympia, Wash., will establish a shingle mill at Shelton, Wash.

The Cockshutt Plow Company, Ltd., Brantford, Ont., intends building a new factory.

The Hancock mine, Mineral Hill, Texas, is to be equipped with $10,000 worth of drills.

The main station at Eureka, Cal., of the Eureka Lighting Company, has been burned.

Edward Hunter, of Seattle, Wash., will equip his Blue Jacket mine with machinery.

The Tom Thumb mine, Republic, Wash., is to be equipped with diamond drills this summer.

A factory at West Hanover, Mass., of the National Fireworks Company, has been burned.

The Oregon Monarch Mining Company, of Sumpter, Ore., will install machine drills this summer.

Philip A. Clum & Co. brass founders, Rochester, N. Y., are about to build a large new plant.

The Beveridge Paper Company, Indianapolis, Ind., is negotiating to establish a plant in Xenia, O.

J. Siler will erect a new lumber mill at South Bend, Wash., with a capacity of 50,000 feet per day.

The Truckee (Cal.) Lumber Company will put in a 130 horse-power wheel to run its new dynamo.

A $40,000 factory building is to be erected at Clinton and Lake streets, Chicago, Ill., for C. H. Besly.

Fall River (Mass.) Foundry & Machine Company proposes to build additions, 50x50 and 30x40 feet.

There is still talk of a merger of the American Car & Foundry Company and the Pressed Steel Car Company.

The Sampson Iron Works, of Stockton, Cal., intend to erect a $50,000 plant as soon as a site can be secured.

The Trump Brothers Machine Company, Wilmington, Del., is about to make additions to several buildings.

Excavation has begun for the new factory to be occupied by the Ames-Dean Carriage Company, Jackson, Mich.

The planing mill of the Tallahalla Lumber Company, Ellisville, Miss., has been burned, other buildings being saved.

The San Bernardino (Cal.) Power Company will take steps to change the E Street Railway into an electric road.

The American Shear & Knife Company, Woodbury, Conn., will soon enlarge its plant. A new engine will be installed.

The Mills-Ellsworth Company, Mansfield, O., manufacturer of buggy shafts and poles, proposes to locate in Keokuk, Ia.

The Empire Gold Mining & Milling Company, near Prescott, Ariz., is arranging to install air compressors and drills.

E. G. Stevenson, of Robinsonville, Ore., will equip his property in the Greenhorn hills with an air compressor and machine drills.

The Leviathan Gold Mining Company, of Los Angeles, Cal., is considering equipping its Arizona property with a 200-stamp mill.

The Monte Christo Mining Company (J. H. Featherstone, of Salt Lake, Utah, manager) will put in a gasoline hoist this summer.

Lumber is arriving at the works of H. M. Williams & Co., manufacturers of plated wire, Attleboro, Mass., for a new factory.

The R. K. Le Blond Machine Tool Company, Cincinnati, O., is putting on an extension for a new engine and blacksmith shop.

The Tacoma (Wash.) Brass & Machine Company will equip its new foundry with up-to-date machinery, including a traveling crane.

The City Council, San Diego, Cal., has instructed the City Engineer to prepare an estimate of the cost of an electric lighting plant.

It is reported from Tucson, Ariz., that Guy Boschke, superintendent of the Sulphide mine, says they will put in a steam hoist and pump.

The Central Manufacturing Company, Chattanooga, Tenn., is making preparations to rebuild a wood-working plant destroyed by fire.

The Dawson Manufacturing Company, automobiles, Basic City, Va., is about to begin the manufacture of electrical machinery.

Shop buildings are to be erected by the West Allis Malleable Iron & Chain Belt Company at the western suburb of Milwaukee, Wis.

An addition is being made to the buildings of the W. Warren Thread Works, Westfield, Mass., and another addition is in contemplation.

Wheeler & Wilson Company, sewing machines, Bridgeport, Conn., has taken out a permit to build a two-story addition to factory.

F. J. Blake, of Stevens Point, Wis., has secured an option on 600 acres of land at Bancroft, and proposes to erect a 10-ton steel plant.

The Bridgeport Wood Finishing Company is preparing to rebuild its factory at Still River, Conn., which was recently destroyed by fire.

Eaton, Cole & Burnham Company, manufacturer of valves, fittings, etc., Bridgeport, Conn., is about building a two-story factory addition.

A considerable portion of the factory of the Seneca Glass Company, Morgantown, W. Va., including valuable machinery, has been burned.

It is reported from Redding, Cal., that O. E. Bennett has purchased the Graham & Allen lumber yard and intends to build a planing mill.

A pipe plant is expected to be built by the American Pipe & Foundry Company, which is composed of W. J. Long, of Bessemer, Ala., and associates.

Ground has been broken for an addition to the plant of the Mueller Manufacturing Company, manufacturer of water and gas specialties, Decatur, Ill.

The mill at Beaumont, Tex., of the Kirby Lumber Company, of Houston, has been burned, but will be rebuilt. The new plant is to cost $100,000.

A new plant will be built for occupation by the Rikerd Lumber Company, lumber, sashes and doors, Lansing, Mich., on the site of the mill recently burned.

C. R. Ray, superintendent of the Gold Hill M. P. & D. Company, Gold Hill, Ore., says a new stamp mill, hoisting works and machine drills will be put in.

The Mountana Verde Copper Company intends to erect a 500-ton reduction plant at Bernice, Mont., this season; F. W. Warnock, Butte, Mont., president.

A water-power hoist, air compressor and other machinery are to be immediately put on the What Cheer Mine, owned by John Landers, of San Francisco, Cal.

The Santa Clara Electric Railway, which has recently purchased the franchise of the Ventura-Bakersfield Company, will locate their power plant at Oxnard, Cal.

A three-story building, 80x200 feet, is to be built for the David Bradley Manufacturing Company, manufacturer of plows, Bradley, Ill., at a cost of $35,000.

At Wheeling, W. Va., the factories of the Acme Box Company and Wheeling Mattress Company and the preserving plant of Exley, Watkins & Co., have been burned.

The Regal Textile Company, Utica, N. Y., will erect a new knitting mill, 156x60 feet and four or five stories high with a basement. The power-house will be detached.

A two-story addition, 40x100 feet, will be built to the factory of the Philadelphia Drying Machinery Company, in the rear of 6721 Germantown avenue, Philadelphia.

The White Mountain Paper Company will erect four big pulp mills in the Saco valley during the next two years. The plans are being drawn at Portsmouth, N. H.

The Ritter Dental Manufacturing Company, Rochester, N. Y., has given an order for a four-story addition to its plant. The company manufactures dental chairs, etc.

D. T. Dudley & Son Company, Wilkinsonville, Mass., is to manufacture edge tools in addition to shuttles which the concern has been making for some fifty years past.

A five-story addition, 129x42 feet, is to be built to the plant of the McMichael & Wildman Manufacturing Company, Norristown, Pa., manufacturer of knitting machines.

The United States Grass Twine Company has purchased 24 acres at Middle Village, Borough of Queens, New York city, and will put up a three-story factory, 150x600 feet.

The electric lighting system at Raton, N. M., is to be enlarged. A 200 horse-power engine will be installed and the system will be changed from direct to alternating current.

The Portland City & Oregon Railway Company will, it is stated, build trolley car shops and a sawmill at Portland, Ore. A quantity of machinery, including a boiler, is on hand.

A press despatch from Reading, Pa., announces that the pattern shop and foundry of the Diamond Drill & Machine Company at Birdsboro, in that county, have been burned.

The Peerless Electric Company has been organized by Warren, O., men to manufacture electrical supplies, and will build a plant in Warren. The company is capitalized at $500,000.

The directors of the Lowe Manufacturing Company and Eastern Manufacturing Company, cotton mill concerns at Huntsville, Ala., have voted to double the capacity of both mills.

Permission has been granted to Bateman, McDougall & Palmer, boatbuilders, Buffalo, N. Y., to build a one-story steel structure. It is proposed to place in it some plate-punching machines.

W. F. Snyder, manager of the Honorine Mining Company, of Salt Lake City, Utah, says the company will put in an electric power plant at its Stockton mine in the near future.

The United States Shipbuilding Company, the trust, has filed incorporation papers at Trenton, N. J., with $3,000 capital stock. Of course this amount will be greatly increased hereafter.

The Rochester (N. Y.) Gas & Electric Company is remodeling a building for a central distributing station. In it will be placed gas engines and generators to the amount of 3,500 horse-power.

The Stoner Iron Works, Riverside, Cal., have been purchased by H. A. Landwehr, and will hereafter be known as the Riverside Foundry & Machine Works; W. H. Morley, superintendent.

The Gould Coupler Company, New York city, is building a new boiler-house at its works at Depew, N. Y. Additional boilers and a 300 horse-power direct-connected engine will be installed.

An establishment for making fire alarms will locate in Buffalo, N. Y. It is to be known as the Wilson Automatic Fire & Alarm System. The manager is understood to be J. S. Craft, of Rome, N. Y.

The Pittsburg Blue Print Company has recently signed articles of agreement with Senor Ernesto Thomas, of Santiago, Chile, to represent it in the countries of Peru, Equador, Colombia, Bolivia and Chile.

Vance Bradenburg & Co., No. 6 Wall street, New York, have bought the Ahogado mine, 20 miles east of Hermosillo, Mex., and will install modern machinery. T. B. Johnson, El Paso, Tex., general manager.

The Williams Tool Company, Erie, Pa., instituted by J. C. Williams, formerly superintendent of the Jarecki Company, is about completing a new factory to make a line of pipe threading and cognate tools.

J. M. Hale Company, H. J. Whitney Company, Harris & Frank and Mullen & Bluett Clothing Company, merchants in Los Angeles, Cal., will build a joint lighting plant for their stores. Each store requires 350 lights.

The Caldwell (O.) Car Manufacturing Company has signed contract and bond for its new factory there. This company will employ at least seventy-five men in the beginning and will increase its force to 150 in the future.

The H. H. Franklin Manufacturing Company, producers of finished castings, Syracuse, N. Y., has decided to equip its new factory with electrical transmission and will install a power-house especially designed for the purpose.

Plans have been made for the consolidation of the repair shops of the Missouri Pacific Railroad at Cypress, near Kansas City, Kan.; at Sedalia, Mo., and Osawatomie, Kan., and the erection of new shops in the East bottoms.

Plans have about been completed for the establishment at Manitowoc, Wis., of a 300x180-foot steam boiler and pulp digester plant. William J. Hess, president of the Manitowoc Steam Boiler Works, is the promoter of the enterprise.

The Jeannesville (Pa.) Iron Works Company, manufacturer of pumping machinery, etc., is about to build a new machine shop, foundry, etc. The main building will be 540x106 feet, arranged for electric traveling cranes, etc.

The Riverside (Cal.) Power Company will construct a six-mile canal along the Santa Ana River. The cost of the complete power plant is estimated at $200,000. Power will be furnished to Riverside, Covina and other towns. W. D. Podley, manager.

The Pittsburgh (Pa.) Construction & Engineering Company is receiving bids on an electric plant to cost $100,000 to be built for the Keystone Electric Light Company at Braddock. The construction includes engines, generators, boilers, feed water heaters, etc.

Huntsville, Ala.'s, eleventh cotton mill will be built this season. New England capitalists have closed a deal with Tracey W. Pratt, president of the West Huntsville Cotton Mills Company, for the establishment of a spinning mill with a capital stock of about $200,000.

The United States Manufacturing Company is to locate in Marion, Ind., and make roller bearing clothes wringers. The National Sweeper Company, of that city, which formerly manufactured both sweepers and wringers, has organized this branch of work under a separate company.

A knitting mill is to be established at Depew, N. Y., by the Depew Knitting Company. The incorporators and directors are W. F. DeWitt and Joseph Stead, of Troy, Pa., and J. R. H. Richmond, A. D. Bissell, Frank H. Goodyear, William B. Cutter and C. W. Hammond, of Buffalo, N. Y.

J. D. Powers, of Schuylerville, N. Y., has purchased the pulp mill of the Freydenburgh Falls Pulp Company, near Plattsburgh, N. Y, with water-power privileges and a piece of land, on which he will erect a sulphite pulp mill and a paper mill with a capacity of 100 tons of paper per day.

Magnolia, Miss., is to have a cotton mill soon, and a cotton seed oil mill a little later on. The cotton mill incorporators are: L. L. Lampton, J. H. Price, J. E. Wolfe, A. D. Felder, S. Cohn, J. E. Norwood, E. W. Reid and W. A. Gill. The same local capitalists are backing the oil mill.

News at Pittsburgh is to the effect that Prof. F. L. O. Wadsworth, of the Western University of Pennsylvania, and W. A. Page have organized a company for the manufacture of prismatic glass in large sheets. The new company, it is said, will build a factory near Morgantown, W. Va.

The Standard Roller Bearing Company, Philadelphia, Pa., has purchased the business, patents and good-will of the Grant Roller Bearing Axle & Wheel Company, of Springfield, O., and is prepared to fill orders for roller bearing axles as made by that concern, in addition to its former line.

Work has begun on the plant of the Empire Shipbuilding Company, at Buffalo, N. Y. It will be operated with electric current from the Falls. The machine shop will be 50x60 feet. One double punch, which will form part of the equipment, weighs 20 tons. Some of the machinery is already on the ground.

It is reported from Los Angeles, Cal., that Gen. A. L. New, of the Pacific Wireless Telegraph & Telephone Company, has secured the government contract for connecting the Farallone Islands and the San Francisco lightship by wireless telegraph. He will establish a plant in San Francisco for the manufacture of the necessary apparatus.

A permit has been taken out to build a two-story brick foundry, with peaked slag roof, 397x80 feet, for Burnham, Williams & Co., proprietors of the Baldwin Locomotive Works, Philadelphia, Pa. It will be situated on the south side of Buttonwood street, from Fifteenth to Sixteenth. The contract price is $135,000.

The Rowbottom Machine Company, Inc., Waterbury, Conn., has been organized with $10,000 capital to design and build special machinery and sheet metal working machinery. The president and manager is Geo. Rowbottom, who has been connected with the Waterbury Farrell Foundry & Machine Company for the past twelve years.

Permits have been issued to the Chicago City Railway Company for a blacksmith shop, 252x92, and a wagon shop, 252x92, cost $24,500; machine shop, 216x202 and 216x40, $100,000; carpenter and paint shop, 302x92 and 302x30, $39,000; power-house, 100x53, $13,000; mill, 272x92 and 273x30, $28,500; frog mill and foundry, 140x92, $25,000.

It is reported from Bakersfield, Cal., that work on the big power plant of the Huntington-Heilman syndicate on the Kern River is about to begin. One thousand tons of machinery and steel will be used. A pipe line is to be built to conduct the water from the mouth of the flume to the power-house. It is expected that 800 men will be put to work.

The Standard Underground Cable Company, Pittsburgh, Pa., has voted to increase the capital stock from $1,500,000 to $2,000,000. With the additional capital it is proposed to enlarge the company's plant at Perth Amboy, N. J. The additions will consist of a wire rod mill, a wire drawing mill and a factory for the manufacture of rubber covered wire and cable.

The planing mill and wood-working department and power plant of the Illinois Car & Equipment Company, Chicago, Ill., have been destroyed by fire. They are to be rebuilt at once and supplied with new machinery. Temporary quarters will be secured in a few days, so work on contracts may be resumed at once. The other departments were not injured, and continue in operation.

Joseph Misko, of New York, head of the Misko Ice Company, has been in Pittsburgh negotiating for a site for a cutlery plant, to be built at a cost of $400,000, and to be operated by a company of New York and Pittsburgh capitalists, with the general offices of the company in the latter place. The company is to be capitalized at $5,000,000 and the plant is to employ 800 men.

The Waterbury (Conn.) Brass Company, one of the constituent corporations of the American Brass Company, is preparing plans for an addition to its plant, about 150x200 feet. It is understood that a part of the building will be devoted to carrying on the business of the Pope's Island Manufacturing Corporation, of New Bedford, Mass., recently acquired by the American Brass Company.

The American Tube & Stamping Company has closed the purchase of 21 acres at Bridgeport, Conn., and will proceed to erect a billet mill and an open hearth steel plant. The material has already been ordered. The plant will be equipped with several electric cranes, and an elevated railway will run around the yard. The plant will have a capacity for the employment of more than 2,000 operatives.

The Leominster (Mass.) Manufacturing Company, engaged in the manufacture of horn goods and celluloid, has been dissolved and a new company organized and incorporated with a capital stock of $100,000. The officers of the new company are Henry F. Sawtelle, president; John Boyle, treasurer, and Charles T. Foster, secretary. The new company is looking about for a site for a new factory.

It is stated that the Corrington Air Brake Company, which was recently incorporated with a capital of $5,000,000, was organized to enter the air-brake field in direct competition with all existing air-brake companies. The apparatus to be manufactured by the company, it is claimed, has received approval of air-brake experts and railroad officials after critical tests on fifty-car trains. It is a New York city concern.

Arrangements are being made to establish a large pulp mill at Tonawanda, N. Y. A. L. Newman, former treasurer of the Indiana Pulp & Paper Company, of Marion, Ind., and partner in the firm owning the Allegan Paper Company, of Allegan, Mich., is at the head of the new company. A. H. Crown, corresponding secretary of the Tonawanda Business Men's Association, has represented the Tonawanda business men in the negotiations.

The Fox Typewriter Company, Grand Rapids, Mich., is making preparations for an enlargement of its factory. A considerable quantity of special machinery will be installed. At present the company is turning out six machines per day. The contemplated improvements will give the plant a capacity of fifteen machines a day, and trade is in sight for practically this output, the foreign trade especially developing at an encouraging rate.

A combination of expansion bolt manufacturers in the United States is on foot. N. Harper Steward, of the Steward & Romaine Manufacturing Company, is said to be acting for a syndicate of Baltimore bankers and to hold the option on five of the principal plants in the country, which will expire about July 15. It is part of the plan, Mr. Steward is reported as saying, to buy the plants outright for cash and combine them into one large plant at or near Philadelphia. The American Bridge Company is thought to be interested.

The capacity of the Structural Steel Car Works in Canton, O., will be doubled. The plant which is now being erected covers a plot of ground 500x175 feet and will soon be completed. Orders for cars have been received which will keep this plant running for a year and a half, and the immense press of business decided the stockholders to begin the erection of a duplicate of their plant as soon as the first is completed. The plant now under construction will cost $200,000, but with the addition of the improvement the investment will reach about $500,000. Col. James M. Guffey, of Pittsburgh, is the heaviest stockholder.

Papers have been filed in New Jersey for the International Stoker Company, with an initial capital of $250,000. The company will manufacture apparatus used principally in the furnaces of steam vessels, and, according to report, will practically absorb all the stoker companies in the country, a rumor which we repeat simply for what it may be worth. It is also reported that the new enterprise will have plants in the United States, Canada, England, France, Germany, Russia and Belgium. It is understood that P. L. Crowe, formerly of the Kansas City Cable Railway Company, will be president of the corporation. Its headquarters will be in New York, London and Vienna. It is said that the capital will soon be largely increased.

At a recent meeting of the controlling interests in the Guanajuato (Mex.) Power & Electric Company it was decided to proceed with the enterprise. The company has a capital of $3,000,000, and it is reported that among those who have taken a financial interest in the corporation are Henry Hine, formerly of the Stanley Electric Company; John Hayes Hammond, C. C. Coffin, president of the General Electric Company; Leonard D. Curtis, Irving W. Bonbright, E. Rollins Morse & Bro., J. F. Bartlett, President Baker, of the Venture Corporation of London, and D. O. Mills. The company, it is said, will sell its power in the Guanajuato district at the rate of $200 (Mexican) per horse-power per year, which is about one-half the present cost of power in that district.

The Coes Wrench Company, Worcester, Mass., has increased its capital stock from $100,000 to $150,000, and deeds have been filed by which Loring Coes conveys to the Coes Wrench Company real estate, including the factories of the Coes Wrench Company, Loring Coes & Co., incorporated, and the new

wrench factory built by Loring Coes & Co., before Loring Coes bought out the interest of John H. and Fred L. Coes in the Coes Wrench Company. The transfer also includes the water rights at Coes Pond. The capital stock of Loring Coes & Co., incorporated, has been liquidated. This is a Massachusetts corporation, and its capital stock is $50,000. The officers of the company which now controls the entire Coes business are: President and treasurer, Loring Coes; assistant treasurer and general manager, Frank L. Coes; the two with Fred W. Blackmer constituting the board of directors.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Patterns and models. 19 Thames st., N. Y.

We solicit inquiries for gear cutting. Benjamin Eastwood Co., Paterson, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Light machine & experimental work; models made. S. Messerer, 15 Springf. av., Newark, N.J.

Offer 25 cents for copy AMERICAN MACHINIST, No. 3, Vol. 20. Address Box 621, AM. M.

Will sell patented machinists' instrument of unusual merit. Morris Chamberlain, Bartley, N. J.

Fine and special machinery and experimental work guaranteed. Wyland Mfg. Co., Williamsport, Pa.

Wanted—A partner with capital to start a cast steel foundry. Address H. C. K., care AMERICAN MACHINIST.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Light and medium machinery built to order; estimates furnished on all kinds of machine work. F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa.

Auction sale of machinery, tools and implements (Isbell Machine Co.), 1st st., bet. 18th and 19th aves., Wakefield, Bronx Borough, N. Y. City, two minutes from Woodlawn Sta., Harlem R. R., June 26, 1902, at 12 noon. George Rudolph, auctioneer.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Mechanical engineer, with offices in Philadelphia, will represent to the Eastern trade meritorious steam, mining, electrical and refrigerating machinery; excellent connections and experiences. L. J. Hollawaith, 412 Girard Building, Philadelphia.

Factory for Sale.—The land and building of the Branford Lock Works are offered for sale, comprising six acres of land and about 90,000 sq. ft. of floor area, together with boilers, engines, pumps, heating apparatus and electric light system; Branford is seven miles east of New Haven, Conn., on the N. Y., N. H. & H. R. R. For particulars address the owner, The Yale & Towne Mfg. Co., 9 Murray st., New York.

For Sale—Valuable real estate and machine shop in the city of Biddeford, Maine; the property known as the Hardy Machine Company, consisting of about thirty thousand (30,000) square feet of land, adjoining the track of the Boston & Maine R. R.; large three-story machine shop and foundry, with first-class machinery and tools for manufacturing the Hardy card grinder, and other machinery; the only general repair shop in this locality. For information apply to the President of the Company.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman seeks position. Box 608, AMERICAN MACHINIST.

Experienced foreman on engine and compressor work open for situation. Box 609, AMERICAN MACHINIST.

First-class metal pattern maker (understands molding machine) wants position. Box 602, AMERICAN MACHINIST.

Swede, lately landed, technical education and 5 years' shop experience, desires position. E. S., 662 Warren st., Brooklyn, N. Y.

Mechanical engineer, chief draftsman, wishes executive position; general experience; age 30. Box 590, AMERICAN MACHINIST.

First-class machinist and toolmaker, with 7 years' experience in Sweden and Germany, desires position. F. T., care AMER. MACHINIST.

Molding machine expert wants position; has 8 years of experience on brass, iron and wood patterns for molding machine. Box 603, AMERICAN MACHINIST.

Wanted—Position as manager or superintendent of engine or tool works; age 35; past 10 years in first-class positions. Box 622, AMERICAN MACHINIST.

Young man desires position as subordinate in drafting room; 5 years' practical shop experience; graduate of a drawing school. Box 620, AMERICAN MACHINIST.

Wanted—Position as designer in a drafting room; 2 years' shop experience and 4½ years' designing; German technical college graduate. Box 613, AMERICAN MACHINIST.

Tool designer wants position; expert at designing tools, jigs, fixtures, etc., for reducing the cost of manufactured articles. Wm. H. Flood, 308 W. 123d st., New York city.

Superintendent of agricultural machine and implement factory desires a change; 12 years' experience; good executive ability and a hustler. Address Box 617, AMER. MACH.

First-class planer hand, 22 years' experience on machine tools, as operator and foreman, desires position as foreman of planer department; age 37; methods up to date. Box 614, AMERICAN MACHINIST.

Draftsman and designer, capable of engineering and superintending, large experience on automatic machinery and tools, age 31, graduate, references, wants to change. Box 600, AMERICAN MACHINIST.

Designing draftsman with extensive experience on machinery and tools for manufacturing purposes; has had experience as foreman toolmaker and is familiar with sheet metal tools. Box 616, AMERICAN MACHINIST.

Mechanical engineer, German, 26 years old, technical graduate, desires position; 5 years' experience designing cranes and all kinds of tools and tool machinery; good character; best references. Address L. E., care AM. M.

Mechanical engineer, experienced in general engineering, drafting, machine, power plant, heavy building construction and shop work incidental thereto; refers to present employers. Address Box 604, AMERICAN MACHINIST.

A widely experienced superintendent and manager of machine works, expert in best shop practice and construction, of reliable executive ability and high-class references, seeks position with progressive and broad-minded concern. Address Y., 635 W. 61st st., Chicago.

Young mechanical engineer, Swiss, European technical training, large experience in designing, installing and erecting steam and electrical plants in first firms in several European countries and U. S., desires change; speaks and writes English, French, German and Italian; best references. Box 612, A. M.

Mechanical engineer, technical graduate, chief draftsman and expert designer, desires change; 8 years' experience as assistant M. E., M. E. and chief draftsman, in shop management, power plant installation, power transmission and design of light, heavy and automatic machinery; best of references. Address M. E., care AMERICAN MACHINIST.

Thoroughly first-class salesman, well posted in iron and wood working machinery, steam practice, etc.; designer of plants; accustomed to closing large contracts; would go to Africa as salesman for a concern handling mining, steam, iron working and wood working machinery; salary $6,000 and expenses; am a cheap man for the right people. Box 605, AMERICAN MACHINIST.

Help Wanted.

Wanted—Good toolmakers. Keystone Electric Company, Erie, Pa.

Wanted—Draftsman on machine tool work. Pittsburgh Machine Tool Co., Allegheny, Pa.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

First-class machine tool designer; a position to take charge is open to the right man. Address Box 606, AMERICAN MACHINIST.

Wanted—A first-class draftsman who is familiar with high-speed engine design; works, Trenton, N. J. Box 610, AMER. MACHINIST.

Several young men, graduates of Stevens Institute or other good school of technology, to learn shop practice. Address M., care A. M.

Wanted—A good modern machine tool designer, accustomed to extra heavy work. Apply, stating where employed, to Box 607, AMERICAN MACHINIST.

All-round machinist and toolmaker, man accustomed to handling help, to act as working foreman. Address Wotton Electric & Mfg. Co., Atlanta, Ga.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Several first-class toolmakers and all-round machinists on small work; up-to-date shop and tools, located in Worcester County, Mass.; state age, experience and wages expected. Box 619, AMER. MACHINIST.

Wanted—Foreman for machine shop doing jobbing work, small and large; in replying give full particulars as to age, experience and whether now employed, and where. Answer Box 576, AMERICAN MACHINIST.

Wanted—Competent draftsman, with experience in designing Corliss, slide-valve and hoisting engines, air compressors and coal-mining machinery; state age, experience and salary expected. Box 618, AMER. MACH.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Assistant manager for plant manufacturing automatic engines and similar machines; limited number of men; must be a good manager of men and thoroughly up on handling work systematically and expeditiously. Address G. B., care AMER. MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Electrical engineer for charge of drawing room; thorough knowledge of electric cranes, machine design and general electric construction; position with large electric concern in Sweden; applicant must speak Swedish. Address G. A. Blume, 4 Lincoln ave., Detroit, Mich.

Turret Screw Machines.—Wanted—A competent man, must be a good mechanic, to take charge of about a dozen hand machines; very few screws, but a great variety of special accurate work; good, steady position; references required. Address or call, The S. S. White Dental Mfg. Co., Prince Bay, N. Y.

Machinist Wanted.—To keep pace with our rapid growth we need an additional number of experienced machinists; we want steady men of good habits, looking for permanent positions; school, home and health advantages of Madison are unsurpassed; write immediately for particulars; state age, experience, etc. Northern Electrical Mfg. Co., Madison, Wis.

Draftsman wanted; experienced man who has done practical work in a modern plant and is familiar with up-to-date methods and devices for "doing things," who can design and make drawings for jigs and fixtures for manufacturing interchangeable work advantageously; state age, experience, wages expected, references. Address Leland & Faulconer Mfg. Co., Detroit, Mich.

Wanted by a large manufacturing concern in Seattle, Washington, a first-class foreman blacksmith; a young, progressive man preferred; must have wide knowledge of all classes of blacksmith work, light and heavy, and above all he must be a good handler of men, familiar with drawings and of fair education. Address, stating full qualifications, reference and monthly salary expected, P. O. Box 319, Seattle, Washington.

Superintendent wanted to take executive charge of the shops of a company near New York manufacturing engines and a variety of special machinery. It requires a young man having a technical education, or its equivalent, of great energy, executive capacity and experienced in shop management; a man worth less than three thousand dollars a year is not wanted. Address, stating age, experience and when available, Box 615, AM. M.

Wanted—Young man as assistant in selling special machinery; must have good knowledge of technical matters and be able to make sketches; experience with presses, dies and sheet metal tools desirable, but not absolutely necessary; must have good address and be able to talk with customer; state age and experience very fully, reference and salary to start; good opening and pleasant position for the right party; Middle West. Address Box 611, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	62
Acme Machinery Co.	18
Adams Co., The	56
Akron Electric Mfg. Co.	68
Albro-Clem Elevator Co.	54
Allington & Curtis Mfg. Co.	61
Almond, T. R.	75
American Fdry. & Mch. Co.	53
American Gas Furnace Co.	15
American Machinery Co.	63
American Tool & Mach. Co.	56
American Tool Works Co.	12
Armstrong Bros. Tool Co.	60
Automatic Machine Co.	62
Automobile & Cycle Parts Co.	51
Baird & Co., Henry Carey	54
Baird Machinery Co., U.	76
Baker Brothers	64
Baldwin, Davidson & Wight	68
Balkwill Pattern Works	58
Ball Bearing Co.	18
Barker & Chard Mch. Tool Co.	77
Barnes Co., B. F.	56
Barnes & Co., W. F. & John	14
Barnett Co., G. & H.	4th Cover
Baush Machine Tool Co.	71
Bay State Stamping Co., The	8
Beaman & Smith Co., The	8 and 66
Belmer Machine Tool Co.	62
Bement, Miles & Co.	2
Besly & Co., Chas. H.	59 and 4th Cover
Bethlehem Fdry. & Mach. Co.	11
Bickford Drill & Tool Co.	6
Bilgram, Hugo	12
Billings & Spencer Co.	4th Cover
Binsse Machine Co.	18
Blanchard Mach. Co.	18 and 75
Bliss Co., E. W.	58
Boker & Co., Herman	64
Boston Gear Works	15
Bowler & Co., Geo. H.	71
Bradford Machine Tool Co.	5
Bremer Machine & Tool Co.	53
Bridgeport Chain Co.	72
Bristol Co.	4th Cover
Brown & Co., R. H.	66
Brown & Sharpe Mfg. Co.	4th Cover
Brown Hoisting Mch. Co.	72
Buffalo Forge Co.	4th Cover
Builders Iron Foundry	3d Cover
Bullard Machine Tool Co.	16
Bullock Electric Mfg. Co.	78
Burt Mfg. Co.	79
Butler, A. G.	16
Caldwell & Son Co., H. W.	73
Carborundum Co., The	52
Card Mfg. Co., S. W.	8
Carpenter Tap & Die Co., J. M.	8
Case Mfg. Co.	72
C & C Electric Co.	71
Champion Blower & Forge Co.	61
Chandler & Taylor Co.	61
Charter Gas Engine Co.	61
Chattanooga Machinery Co.	11
Chicago House Wrecking Co.	78
Chicago Pneumatic Tool Co.	75
Chicago Raw Hide Co.	78
Chicago Ship Building Co.	77
Christensen Engineering Co.	75
Church Mfg. Co.	64
Cincinnati Mach. Tool Co.	16
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	16
Cincinnati Shaper Co.	18
Clark Auto. Telephone Switch Board Co.	53
Clark, Jr., & Co., Jas.	71
Cleveland Crane & Car Co.	72
Cleveland Gear Works	66
Cleveland Machine Screw Co.	57
Cleveland Pneumatic Tool Co.	52
Cleveland Punch & Shear Wks. Co.	80
Cleveland Stone Co.	16
Cleveland Twist Drill Co.	4th Cover
Cleveland Wire Spring Co.	61
Clough, R. M.	54
Coes Wrench Co.	10
Columbus Machine Co.	61
Commercial Electric Co.	70
Consolidated Engine Stop Co.	61
Consolidated Schools	56
Cook Co., Asa S.	66
Crane Co.	60 and 73
Crocker-Wheeler Co.	70
Crosby Stm. Gage & Valve Co.	15
Cullen, Orlan Clyde	68
Curtis & Curtis Co., The	62
Cushman Chuck Co.	66
Dallett & Co., Thomas H.	62
Dawson Mchry. Co., J. H.	77
Detrick & Harvey Machine Co.	58
Diamond Drill & Machine Co.	55
Diamond Saw & Stamp. Wks.	78
Dixon Crucible Co., Joseph	56
Dreses Machine Tool Co.	10
Dustin Co., Chas. E.	76
Dwight Slate Machine Co.	62
Errington Auto. Tap & Die Co.	67
Etna Mfg. Co.	67
Evans Friction Cone Co.	67
Excelsior Needle Co.	78
Fairbanks Co., Philadelphia	77
Fairbanks Co., The, New York	77
Faneuil Watch Tool Co.	80
Fawcus Machine Co.	58
Fay & Scott	8
Fellows Gear Shaper Co.	60
Field, Chas. H.	62
Flather Planer Co., Mark	52
Foos Gas Engine Co.	61
Franklin Mfg. Co.	68
Franklin Portable Crane & Hoist Co.	72
Frick Co.	61
Garvin Machine Co., The	77
Gates Co., Fred. P.	67
Gay & Ward	14
General Elec. Co.	69
Geometric Drill Co.	66
German Niles Tool Works	13
Gisholt Machine Co.	63
Gleason Tool Co.	4th Cover
Gobeille Pattern Works	18
Gorton Machine Co., Geo.	62
Gould & Eberhardt	18
Graham Mfg. Co.	17
Grant Gear Works	18
Grant Mfg. & Mach. Co.	18
Grant Tool Co.	74
Gray & Prior Machine Co.	52
Gray-Blaisdell Co.	79
Gray Co., G. A.	18
Greenwald Co., I. & E.	53
Hammacher, Schlemmer & Co.	53
Hampden Corundum Wheel Co.	66
Harrington, Son & Co., Inc., Edw.	17
Harris & Co., Sam'l	66
Hart Mfg. Co.	55
Hartford Steam Boiler Insp. & Ins. Co.	55
Hendey Machine Co.	51
Henley & Co., N. W.	53
Herron & Bury Mfg. Co.	73
Hill, Clarke & Co.	13, 66 & 77
Hilles & Jones Co.	54
Hoefer Mfg. Co.	8
Hoggson & Pettis Mfg. Co.	67
Horsburgh & Scott	4th Cover
Horton & Son Co., E.	66
Houghton & Co., E. F.	57
Howard Iron Works	58
Hunt Co., C. W.	72
Hunt Co., Robt.	61
Hurlbut-Rogers Machine Co.	11
Ingersoll Milling Mach. Co.	60
Ingersoll-Sergeant Drill Co.	75
International Steel & Mchry. Co.	64
Iroquois Machine Co.	63
Jacobson Machine & Mfg. Co.	8
Jantz & Leist Electric Co.	68
Jeffrey Mfg. Co., The	77
Jenkins Brothers	60
Jones & Lamson Machine Co.	18
Kelly Machine Co., R. A.	53
Kempsmith Mfg. Co.	52 and 77
Keuffel & Esser Co.	56
Kilbourne & Jacobs Mfg. Co.	61
Landis Tool Co.	57
Le Blond Machine Tool Co., R. K.	4th Cover
Le Count, Wm. G.	66
Leland & Faulconer Mfg. Co.	54
Link-Belt Engineering Co.	73
Lodge & Shipley Mch. Tool Co.	4
Long & Allstatter Co.	55
Lorentz & Evarts	78
Lunkenheimer Co., The	60
McCabe, J. J.	17 and 76
McKenna & Bro., Jas. J.	64
Maris Bros.	72
Marshall & Huschart Mch. Co.	77
Merrell Mfg. Co.	60
Merrill Bros.	54
Merritt & Co.	60
Miami Brass Works	64
Mich. College of Mines	16
Mietz, August	61
Mitts & Merrill	16
Morse Twist Drill & Mach. Co.	17
Morse, Williams & Co.	54
Mossberg & Granville Mfg. Co.	74
New Era Iron Works Co.	61
New Haven Mfg. Co.	56
New Process Raw Hide Co.	71
Newton Mach. Tool Wks., Inc.	11
Nicholson & Co., W. H.	75
Nicholson File Co.	51
Niles Tool Works Co.	76
Northampton Emery Wheel Co.	58
Northern Electric Mfg. Co.	70
Northern Engineering Works.	72
Norton Emery Wheel Co.	71
Nuttall Co., R. D.	65
Obermayer Co., The	64
Oesterlein Mach. Co.	73
Olds Motor Works	61
Osborn Machinery Co.	77
Oster Mfg. Co.	67
Parker Co., Chas.	62
Patriarche & Bell	64
Patterson, Gottfried & Hunter Co., Ltd.	14
Pawling & Harnischfeger	72
Pearson Machine Co.	58
Philadelphia Pneu. Tool Co.	59
Pittsburg Shear Knife & Mach. Co.	54
Pond Machine Tool Co.	3
Poole & Son Co., Robert	15
Potter & Johnston Co.	10
Pratt & Whitney Co.	65 and 3d Cover
Pratt Chuck Co.	66
Pratt Institute	68
Prentiss Tool & Supply Co.	76
Purdue University	16
Putnam & Co.	70
Quint, A. D.	54
Rand Drill Co.	75
Reade Machinery Co.	80
Reed Co., F. E.	55
Reeves Pulley Co.	73
Regal Gas Engine Co.	61
Rivett Lock Co.	80
Robbins & Myers Co., The	68
Rogers, Boat, Gage & Drill Works, John M.	65
Roller Bearing & Equip. Co.	18
Roth Bros. & Co.	68
Safety Emery Wheel Co.	55
Saunders' Sons, D.	55
Sawyer Tool Mfg. Co.	65
Schumacher & Boye	9
Schwerdtle Stamp Co.	66
Sebastian Lathe Co.	58
Sellers & Co., Inc., William	18
Seneca Falls Mfg. Co.	52 and 67
Shultz Belting Co.	18
Sibley & Ware	64
Simonds Mfg. Co.	12
Skinner Chuck Co.	66
Slocomb & Co., J. T.	64
Sprague Electric Co.	68
Springfield Gas Engine Co.	61
Standard Connecting Rod Co.	60
Starrett Co., L. S.	11
Steptoe & Co., John	18
Stevens & Co., Milo B.	68
Stover Engine Works	61
Stowell, J. A.	60
Struthers, Wells & Co.	61
Stuart's Foundry & Mach. Co.	4th Cover
Tabor Mfg. Co.	59
Thompson, Hugh L.	64
Toomey, Frank	77
Triumph Electric Co.	68
Trump Brothers Machine Co.	66
Underwood & Co., H. B.	62
Uniform Steel Co.	79
U. S. Metallic Packing Co.	53
U. S. Steel Co.	64
Universal Drafting Machine Co.	3d Cover
Vanderbeek Tool Works	62
Veeder Mfg. Co.	55
Waltham Watch Tool Co.	73
Ward & Son, Edgar T.	64
Warner & Swasey Co.	58
Watson-Stillman Co.	67
Weber Gas & Gasoline Eng. Co.	61
Westcott Chuck Co.	66
Western Electric Co.	71
West Haven Mfg. Co.	4th Cover
Westinghouse Elec. & Mfg. Co.	69
Wheaton Machine Co.	58
Whitcomb Mfg. Co.	63
Whiting Foundry Equip. Co.	72
Whitney Mfg. Co.	1
Whiton Machine Co., D. E.	67
Wiley & Russell Mfg. Co.	52
Williams & Co., J. H.	12
Windsor Machine Co.	53
Winkley Co., The	75
Wire Belt Lace Co.	53
Wold & Co., Torris	55
Woodward & Powell Planer Co.	54
Worcester Mach. Screw Co.	62
Wormer Machinery Co., C. C.	76
Wyke & Co., J.	56
Wyman & Gordon	4th Cover
Yale & Towne Mfg. Co.	72

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Accident Cabinet

Putnam & Co., New York.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Ball Bearings

See Roller Bearings.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton, E. F., Philadel., Pa.

Belt Fastener
Wire Belt Lace Co., Rochester, N. Y.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather
Shultz Belting Co., St. Louis, Mo.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Blocks and Tackles
See Hoists, Hand.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry Co., Cleveland, O.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Boilers
Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical
Baird & Co., Henry Carey, Philadelphia, Pa.
Henley & Co., N. W., New York.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
See Grinding.

Castings, Iron
Church Mfg. Co., Adrian, Mich.

Castings, Aluminum and Brass
Christensen Engineering Co., Milwaukee, Wis.
McKenna & Bro., Jas. J., New York.
Miami Brass Works, Hamilton, O.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.
U. S. Steel Co., Everett, Mass.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Ct.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Driving
Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Gates Co., Fred P., New London, Conn.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. & Mfg. Co., Warren, Pa.
New Haven Mfg. Co,. New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Gray & Blaisdell, Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Counters
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wheaton Mach. Co., Boston, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Wold & Co., Torris, Chicago, Ill.

Drafting Machine
Universal Drafting Mach. Co., Cleveland, O.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Nues Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, Worcester, Mass.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Radial
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrically-Driven Tools.
Clark, Jr., & Co., Jas., Louisville, Ky.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Stover Engine Works, Freeport, Ill.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers, Wells & Co., Warren, Pa.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Grindstones
Cleveland Stone Co., Cleveland, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Stm. Boiler Ins. & Insp. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Harris & Co., Saml., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Auto. Mach. Co., Bridgeport, Ct.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F., & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Stowell, J. A., Leominster, Mass.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Owen Mach. Tool Co., Springfield, Ohio.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.
Lorentz & Evarts, Hartford, Conn.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Beimer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mgf. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua,

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Rods and Straps, Connecting.
Standard Connecting Rod Co., Beaver Falls, Pa.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Dill Mach. Co., T. C., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves Pop
Crane Co., Chicago, Ill.
Crosby tSeam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
Pratt Institute, Brooklyn, N. Y.
Purdue University, Lafayette, Ind.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses Mach. Tool Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Chicago House Wrecking Co., Chicago, Ill.
Dawson, John H., Chicago, Ill.
Dustin Co., Chas. E., New York.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Osborn Mchry. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shafts, Crank
Standard Connecting Rod Co., Beaver Falls, Pa.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New Haven.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Wks., Phila., Pa.
Dill Mach. Co., T. C., Phila., Pa.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven. Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Herman Boker & Co., New York.
International Steel & Mchry. Co., New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Herman Boker & Co., New York.
International Steel & Mach. Co., New York.
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Works, Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

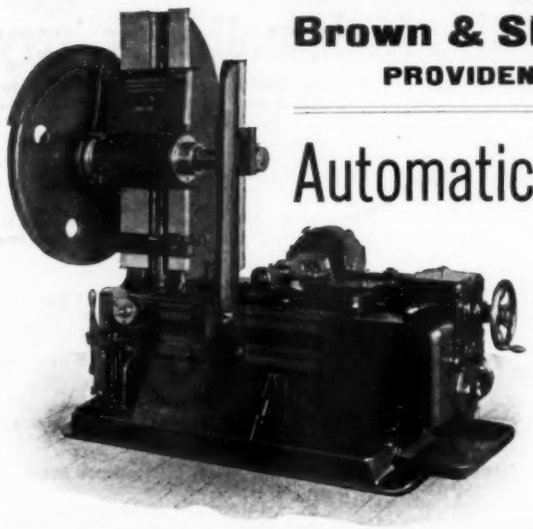
Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

9



Brown & Sharpe Mfg. Co.

PROVIDENCE, R.I., U.S.A.

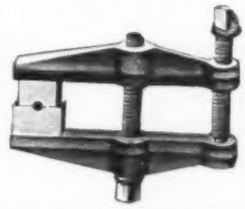
Automatic Gear Cutting Machines

For Spur and Bevel Gears.

Catalog and circulars give detailed information.

Billings' Drop-Forged Machinist Clamp

Forged from Bar Steel



A Useful Tool for Machinists or Toolmakers

The designer of this clamp, as shown in the cut, claims nothing particularly new, except it being drop forged and the stock distributed in a way to overcome weak points.

We make four sizes

Also DROP FORGINGS of every description

The Billings & Spencer Co.

HARTFORD, CONN., U.S.A.

London Office: No. 8 Long Lane, Aldersgate St., London, E. C., England.

Black Diamond Files and Rasps

PERFECT ALWAYS

TRADE MARK.

Twelve Medals Awarded at International Expositions

TRADE MARK.

For Sale Everywhere

G. & H. BARNETT CO., - Phila., Pa.

"We manufacture six sizes of Plain, and four sizes of Universal Milling Machines. Send for description of special features.

The R. K. LeBlond Machine Tool Co.,

Cincinnati, Ohio.

The Niles Tool Works Co., Eastern Agents. J. Lambercier & Co., Geneva, Sole Agents for Switzerland.

Why HAGGLE over a trifling difference in Price? Price doesn't count when one drill will do 25% to 50% more work than another.

CLEVELAND TWIST DRILL CO.,

CLEVELAND. NEW YORK. CHICAGO.

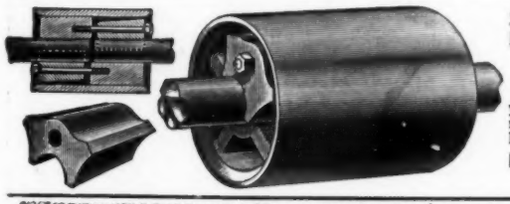
BUFFALO FANS

FOR HEATING, VENTILATING, DRYING, MECHANICAL DRAFT, ETC.

CATALOG?

BUFFALO FORGE COMPANY

BUFFALO, N. Y.



Stuart's Patent **Compression** Wedge Coupling

Requiring No Keys

Has successfully stood the test for eleven years, and is still being shipped on trial, or money returned if you want it. All sizes kept in stock.

R. J. Stuart's Foundry & Machine Works, NEW HAMBURG, N. Y.

ANGULAR GEARS AT THE SAME PRICE AS BEVELS

GLEASON TOOL CO. ROCHESTER, N.Y.

Drop Forgings

IRON, TOOL-STEEL SOFT-STEEL, COPPER.

Send Model or Sketch for Estimate.

WYMAN & GORDON

WORCESTER, MASS.

Bristol's Patent Steel Lacing.

The most perfect fastening for all kinds of belting. Greatest Strength Least Material.

Ready to Apply. Finished Joint. SAMPLES FREE.

THE BRISTOL CO., - - WATERBURY, CONN.

RAWHIDE GEARS

MANUFACTURED BY HORSBURGH & SCOTT, Cleveland, Ohio.

Hack Saws For Every

possible purpose. For cutting any sort of metal. These are Hack Saws of a known and tried quality. Ask for details.

WEST HAVEN MFG. CO., New Haven, Conn.

RUST

On Tools, Guns, Cycles, etc., absolutely prevented by using MANNOCITIN. Shore gunners say it's the only absolute rust-preventive. Sample can, Twenty-five Cents. Ask for booklet.

C. H. Besly & Co., Agts 10 N. Canal St., Chicago, Ill.

Pratt & Whitney Co.

HARTFORD, CONN.

OFFICES:

New York, 136-138 Liberty Street. Boston, 144 Pearl Street. Chicago, 46 So. Canal Street. St. Louis, C. A. Thompson, 516 N. Third Street. Philadelphia, 21st and Callowhill Streets. Pittsburg, D. L. Macomber, Frick Building Montreal, Chas. Spalding, 50 Cathcart Street. Mexico City, Robert Boker & Co.

14" Lathes for Immediate Delivery

We have unsold a few of the present lot of our new model 14 in. Engine Lathe, swinging 15 7-8 inches over shears, especially adapted for tool room use.

The longitudinal and Transverse alignments are practically perfect, all bearings have great length and surface and are scraped to fit. Special attention is called to the bed, which is of box form, giving greatest resistance to bending and torsional strains.

Taper Attachment

Is graduated and provided with adjusting screws; is clamped to cross slide by one bolt by operator from in front; has only one working joint and this is provided with taper gib; is rigid and accurate.

Relieving Attachment

Is furnished to order for relieving straight, taper and, when called for, spiral milling cutters and taps. It is EFFICIENT.

Draw-back Collet Mechanism

Is furnished to order with nine collets ranging from 3/16 inch to 3/8 inch by sixteenths.

Step Chucks and Closers.

Four blank split step chucks suitable for short work from 3/8-inch to 6-inch diameter and two closers are furnished with Draw-back Collet Mechanism to order.

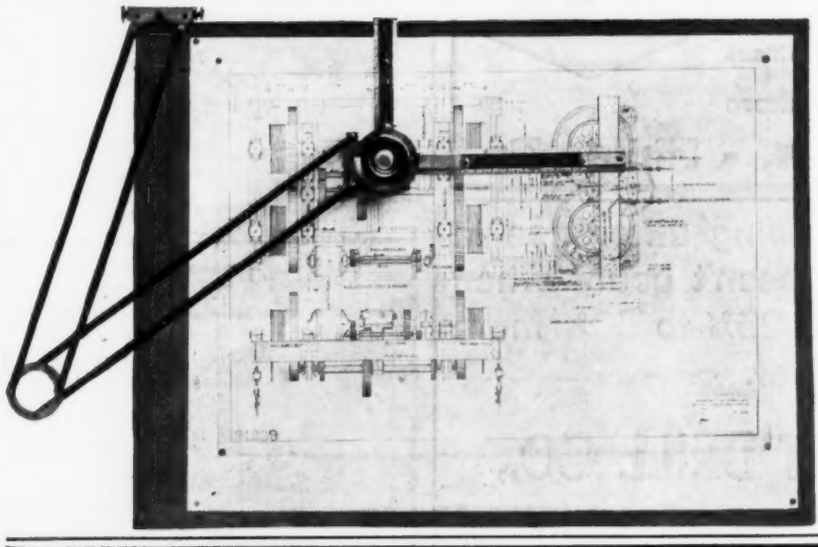
These attachments give to this lathe every convenience hitherto largely associated with Bench Precision Lathes.

This lathe is recommended both on account of its accuracy and convenience for the highest grade of tool making.

Net weight is fully 25% heavier than any other machine of similar size now on the market.

Call and inspect our lathes at our Branch Offices.

The Universal Drafting Machine is a Time Saver



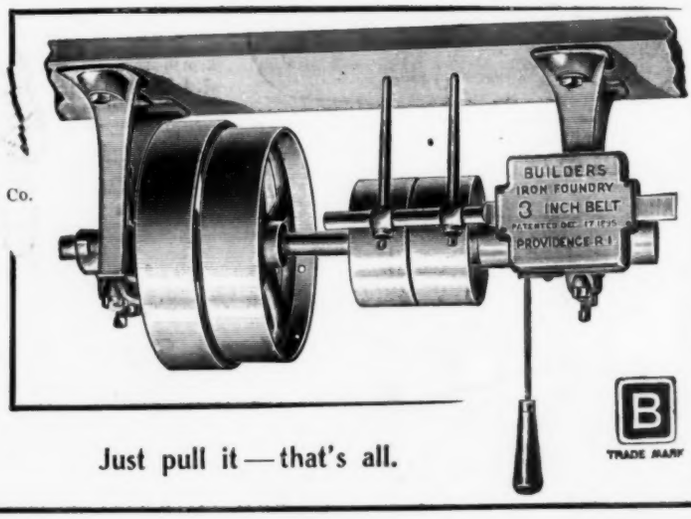
It's almost as direct as free-hand. Simple, too—just a graduated square, with an accurate parallel motion about the board, and a protractor that makes the square universal, so it can be quickly clamped at any angle. Lines are drawn and measured at the same time—right angle, right length. Has spring stops for angles of 30°, 45° and 60°. Built to last. Do you want the book that tells all about it?

Universal Drafting Machine Company,

Blackstone Bldg., CLEVELAND, O.

A Patent Countershaft with Self-Contained Belt Shifter.

Pull to start it — pull to stop it. Can be placed at any height. Works equally well high or low. Rope so arranged it can be passed around pulleys, led along any large machine and belt controlled from any point. The other "points" are yours for the asking. Catalog?



Builders Iron Foundry,

Providence, R. I., U.S.A.

Just pull it — that's all.